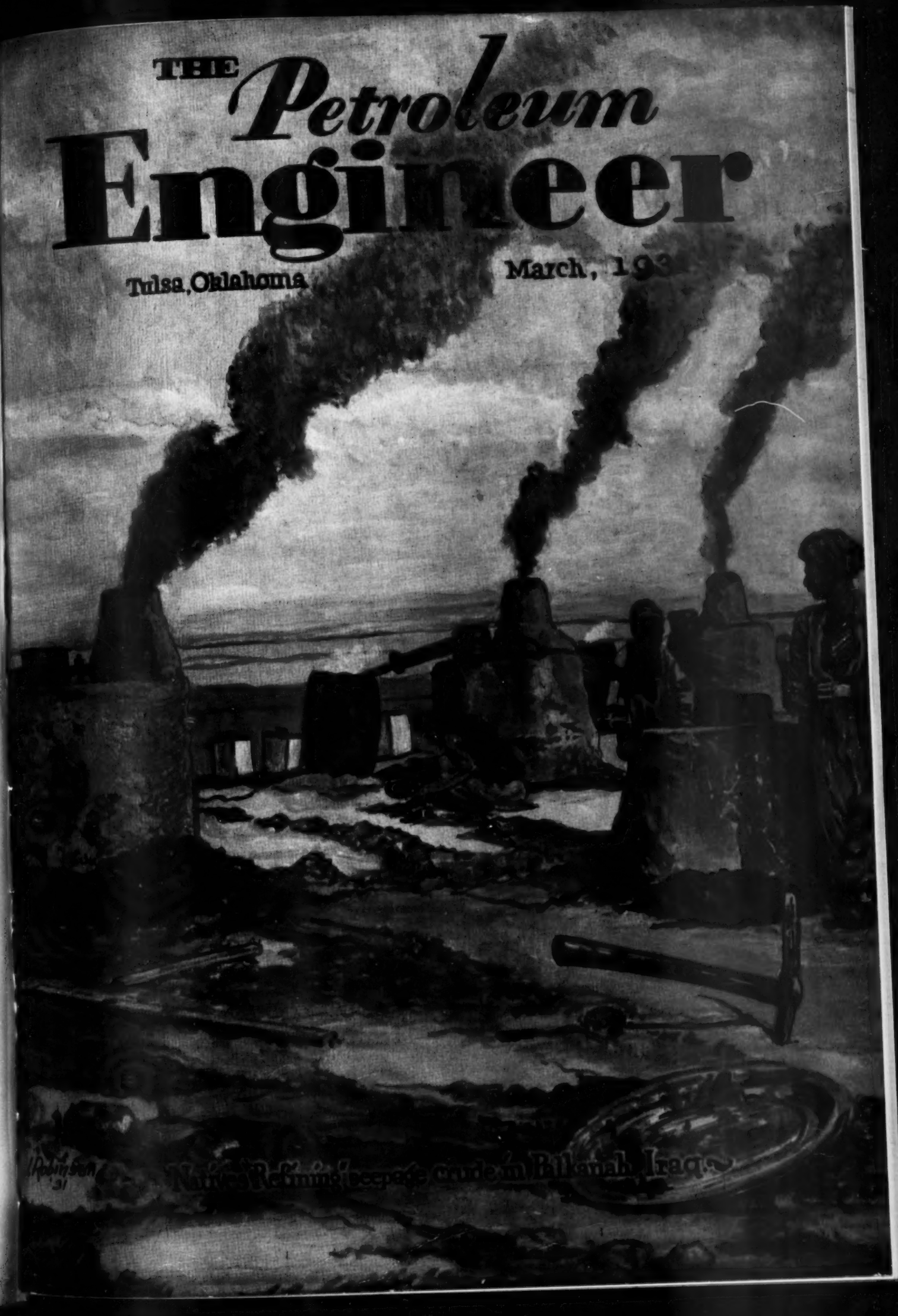
THE Petroleum Engineer

Tulsa, Oklahoma — March, 193



The Sharples Process

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The Processes
of Contact Filtration

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The Gyro Process
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X B. MILL

FIFTH AVENUE

Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Edited and Circulated Only for those Actively Engaged in the Operating Departments of the Industry

SUBSCRIPTION PRICE

Single copies, 25 cents. Domestic and foreign, $1.00 per year.

Published 13 times a year; monthly on the 15th with the exception of June, in which two issues appear—the Engineering Review number on the first and the regular June issue on the 15th.

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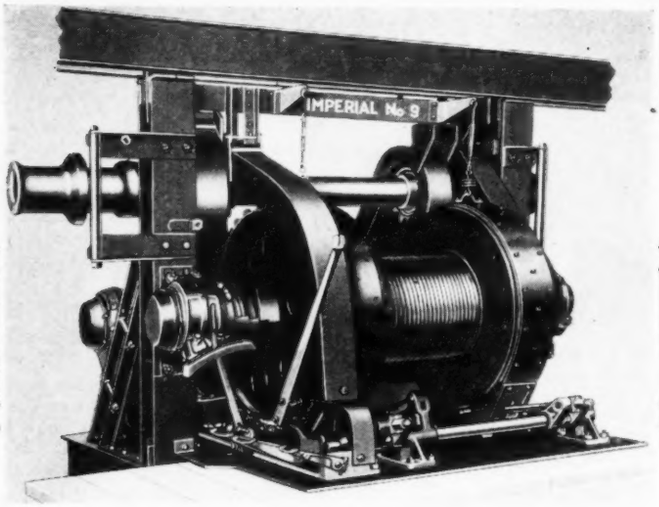
THE STANDARDIZED HEAVY DUTY BEARING OF THE OIL INDUSTRY

PROGRESS in HOISTS



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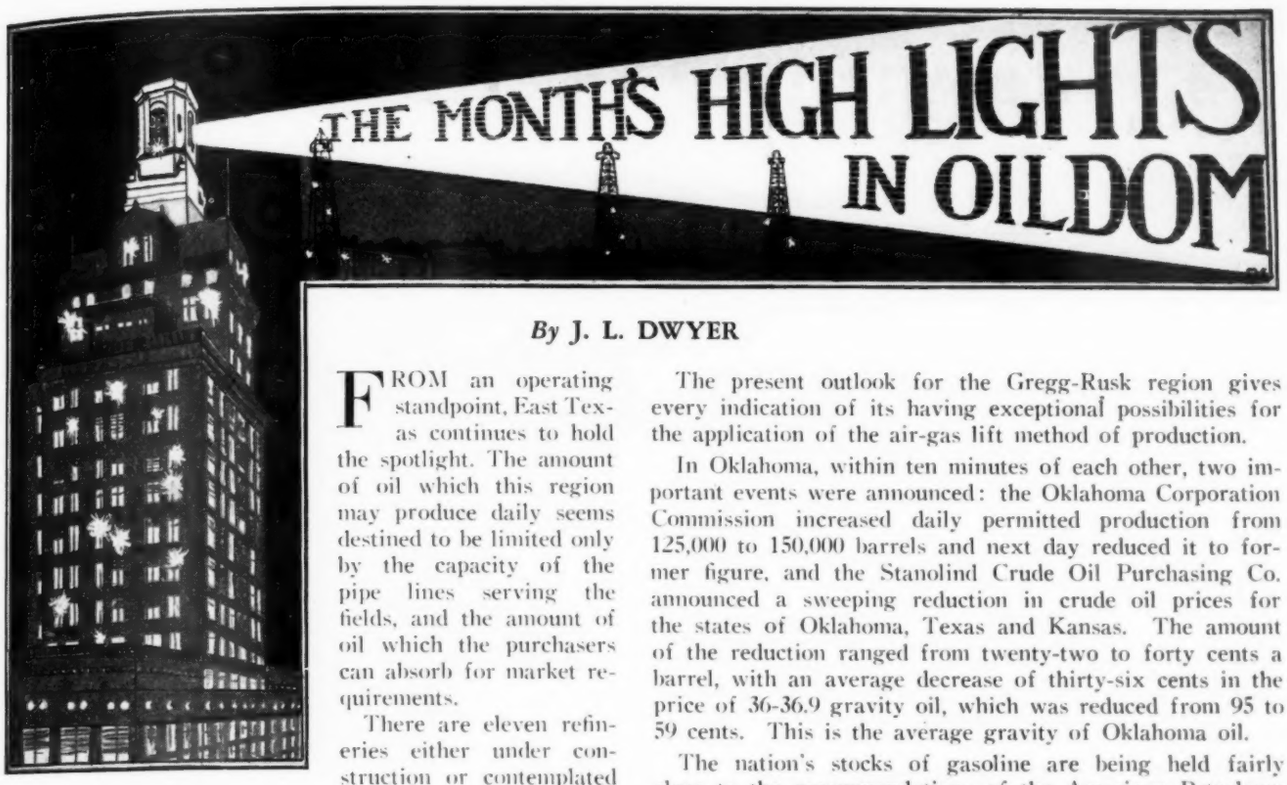


By **J. L. DWYER**

FROM an operating standpoint, East Texas continues to hold the spotlight. The amount of oil which this region may produce daily seems destined to be limited only by the capacity of the pipe lines serving the fields, and the amount of oil which the purchasers can absorb for market requirements.

There are eleven refineries either under construction or contemplated for the East Texas region, and they will have a combined daily throughput of 50,000 barrels.

From a mechanical point of view there has been little change in the operating conditions of Rusk and Gregg Counties' activities. The drilling is still easy, permitting the use of medium weight equipment. Recently several strings of tools have been moved to this new field from the Oklahoma City territory, and the performance of the heavier rotaries will be observed with much interest.

Although several wells located on what is believed to be the less favorable portion of the structure have stopped their natural flow, little apprehension is felt over the prospects of the region. According to field reports the general producing condition reveals a good saturation, and while sensitivity of pressure is apparent, this will have little effect upon the ultimate recovery per acre of the fields. The Greater Seminole area of Oklahoma presented similar conditions of pressure, and established excellent yield records.

The present outlook for the Gregg-Rusk region gives every indication of its having exceptional possibilities for the application of the air-gas lift method of production.

In Oklahoma, within ten minutes of each other, two important events were announced: the Oklahoma Corporation Commission increased daily permitted production from 125,000 to 150,000 barrels and next day reduced it to former figure, and the Stanolind Crude Oil Purchasing Co. announced a sweeping reduction in crude oil prices for the states of Oklahoma, Texas and Kansas. The amount of the reduction ranged from twenty-two to forty cents a barrel, with an average decrease of thirty-six cents in the price of 36-36.9 gravity oil, which was reduced from 95 to 59 cents. This is the average gravity of Oklahoma oil.

The nation's stocks of gasoline are being held fairly close to the recommendations of the American Petroleum Institute, which were made at the annual meeting of that organization last November.

The Western Petroleum Refiners' Association presented an unusually interesting programme at their annual meeting held at Excelsior Springs, Mo., March 10 to 12th. Many papers dealing with operations were read.

Recent developments in Mississippi include completion of a well making 45,000,000 cubic feet of gas daily from a depth of 2,490 feet. Oil production in important quantities in Mississippi would cause little surprise, as the geological possibilities of the territory are considered exceptional.

In the California fields, Kettleman Hills shows some signs of increased activities. There have been several new wells started in this region. While the Kettleman North Dome Association will not start its official existence until April 1, it is reported that the operators in this group are in substance carrying out the programme which has been outlined.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline Stocks and Gas and Fuel Oil Stocks, Week Ending February 28, 1931

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Average Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	450,700	73.6	7,745,000	7,331,000
Appalachian	93.8	91,600	69.1	1,408,000	1,063,000
Ind., Ill., Ky.	97.5	272,600	71.5	4,983,000	3,054,000
Okla., Kan., Mo.	89.4	251,700	61.1	3,119,000	3,735,000
Texas	91.9	535,800	72.1	7,004,000	9,313,000
Louisiana-Arkansas	98.3	137,300	52.4	1,722,000	2,295,000
Rocky Mountain	93.1	47,700	34.1	1,816,000	971,000
California	98.8	483,000	54.4	15,811,000	101,310,000
Total Wk. Feb. 28	95.7	2,270,400	63.6	43,608,000	129,072,000
Total Feb. 28, 1930	95.4	2,516,100	72.2	*51,936,000	**137,992,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.					
Texas Gulf Coast	100.0	399,400	75.4	5,739,000	6,933,000
Louisiana Gulf Cst.	100.0	91,300	61.9	1,526,000	1,262,000

*Revised due to change in California gasoline stocks.

**Revised due to change in California and Louisiana-Arkansas gas and fuel oil stocks. (California, +281,000; Louisiana-Arkansas, +803,000.)

Daily Average Production

(Figures in Barrels)

	Feb. 28 1931	Jan. 24 1931	Feb. 22 1930
Oklahoma	502,550	466,900	646,800
Kansas	116,150	107,300	110,600
Panhandle Texas	53,950	57,850	89,000
North Texas	58,650	62,700	81,000
West Central Texas	23,950	25,500	53,050
West Texas	244,200	249,850	340,700
East Central Texas	68,350	44,600	23,600
Southwest Texas	78,800	77,800	66,750
North Louisiana	44,900	40,400	41,700
Arkansas	49,850	50,650	58,150
Coastal Texas	157,200	159,900	175,000
Coastal Louisiana	26,450	27,200	22,950
Eastern (not including Mich.)	100,350	99,500	120,400
Michigan	9,350	9,250	13,800
Wyoming	45,550	45,400	49,200
Montana	9,350	6,850	8,250
Colorado	4,300	4,500	4,850
New Mexico	40,950	39,250	10,250
California	530,400	535,200	806,000
Total	2,165,250	2,110,600	2,722,050

Continental's Glenrock Plant Is

« « ——— « « By F. R.

THE refining facilities of the Continental Oil Co. have been further extended recently by the acquisition of a refinery in Lewistown, Montana, and one in Albuquerque, New Mexico. A new refinery in Denver started operating the first of this year. The company now operates eleven refineries.

The operating efficiency of the Glenrock, Wyoming, refinery, like that of all the other Continental properties, is reflected in its excellent general appearance, its cleanliness, and its well-painted equipment. The plant has a capacity of 3,500 barrels of crude per day. It is a skimming and coking plant, and the cracking of the distillates is done in a Standard Oil Refinery adjacent to it. Big Muddy crude is processed. This is a sweet crude having an average gravity of 33 A. P. I. It yields about 25 per cent of straight run gasoline and six per cent of kerosene distillate.

The distillation equipment consists of a battery of five shell stills and a battery of four coke stills. The pressure distillate is rerun in a shell still. The crude stills in the battery are 8 by 40 feet, equipped with bubble type fractionating towers. The layout of the crude battery lends itself to a great flexibility. The operation can be changed in a few hours to make a Stoddard solvent cut in addition to the gasoline and kerosene distillates. Vapor heat exchangers are installed on four of the stills. The battery is operated continuously, using recirculating pumps. The lines are so arranged that the crude can be charged to the first still or be divided between the two lead stills entering the towers of each. The residuum from the last still is pumped while hot to the coke stills. The transfer from one still to another is accomplished in each case by means of pumps.

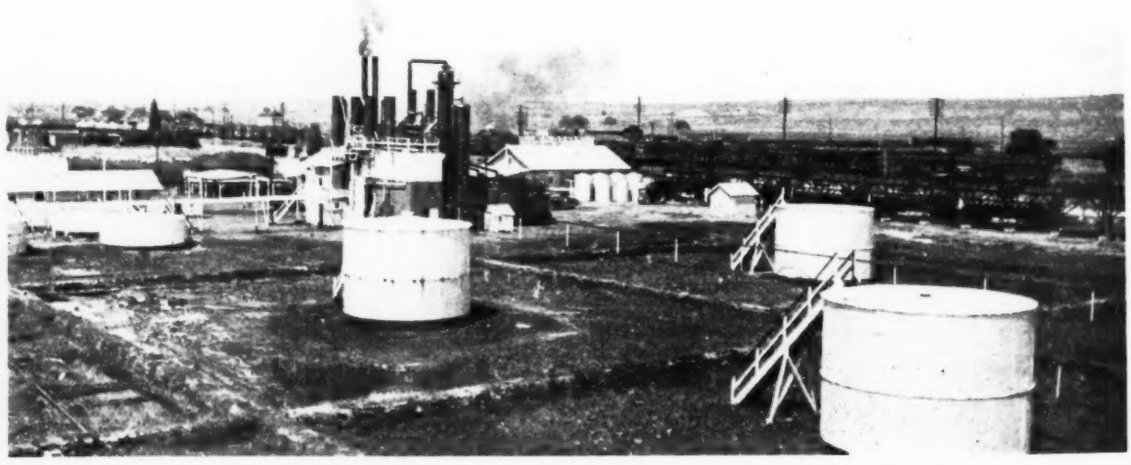
The usual method of operation is to take a gasoline stream from the first tower, followed by a kerosene stream from a second tower, with a gas oil cut coming from the final still in the battery. The gasoline may be taken off in two fractions from two lead stills, or a Stoddard solvent cut can be made on second tower, following a light gasoline fraction. The feed to each still is delivered to the corresponding bubble tower, where the vapors are liberated and the residuum flows downward to the base of the tower and from there to the still. Reboiling is accomplished by returning vapor to the bottom of the towers from the stills. Only one overhead fraction or product is recovered from each still.

The vapors leaving the towers pass through heat exchangers of the hairpin type where part of the heat content is recovered by absorption in the crude oil to be charged to the lead still. The cooled vapors are condensed in section condensers, following which the condensate flows to rundown tanks prior to returning as reflux or to finishing. After being stripped of gasoline, kerosene, and a light gas oil, the residuum is accumulated in an extra still of the battery until bottoms from about 600 barrels of crude are available. This amount is pumped hot to a coke still.

The operation of the crude battery is almost automatic, since control instruments are used throughout. The crude charged to the battery is controlled by means of a flow controller and the vapor temperatures on top of the tower are controlled by means of refluxing a portion of the condensate over the towers. Recording instruments are used throughout the system, charting all the important temperatures.

Natural gas is used as fuel in the plant. Fuel oil can be used whenever necessary. A steam super-heater is located in the flue of one of the lead stills. Super-heated exhaust steam is used in one of the towers for reboiling.

The coke stills consist of a battery of four 14 by 40-foot shell stills. They are equipped with dephlegmating towers which separate vapors into a light overhead and a heavy bottom stream. Each still is charged with a mixture of residuum from the crude stills and heated fuel oil from the pressure distillate. In the operation the stills are fired to maintain a maximum distillation rate, without exceeding a still pressure of five pounds per square inch. It is important that the distillation continue very rapidly; otherwise a lull in firing may permit the deposition of a thin layer of coke on the still bottom through which it will be impossible to force sufficient heat to coke the remaining oil satisfactorily, and in addition, the steel will be greatly overheated.



Continental Oil Company's refinery at Albuquerque, New Mexico.

Highly Efficient in Operation

STALEY »»═══»»

Still bottoms fail eventually due to the weight of coke causing the steel sheets to become thin while heated, and also due to oxidation. The effect of both agents is accelerated by overheating.

The distillates contain about ten per cent of light products formed by atmospheric cracking of the charge while decomposing into coke. This is subsequently removed by rerunning the gas oil. The coke weight per still is approximately six tons, this volume having been found to be most economical from standpoint of cleaning time and cost, as well as protecting the still bottoms from excessive thinning.

After coking a charge of oil, during which the still bottom has been heated a cherry red temperature, the still is allowed to cool for an hour while the color disappears. Steam is now introduced to remove all vapors. After thorough steaming, and after washing condenser coils with hot water from the condenser box, the top head of the still is opened, and the still is steamed to the air for two hours. This completes the preparation for cleaning. A steam jet is placed at the rear top manhole to maintain a draft of air through the still to enable cleaners to enter and remove the coke. The temperature is about 200 degrees.

Two men clean the coke from the stills. The coke is handled by means of a 24-inch gauge railway system. Dump cars having a capacity of about a ton are moved with a three-ton locomotive powered by a model A Ford engine. The coke is moved over a 10-ton platform scale and quenched by means of water spray in order to cool it below ignition temperatures. It is then hauled to storage.

The gas oil produced from the coke stills contains about 10 per cent of light ends. This gas oil, together with the cycle stock from the pressure stills, is charged continuously to a stripper still equipped with a heat exchanger and a 5 by 20 fractionating packed column. The still is 6 by 40 feet. The charging rate of 1,800 barrels can be maintained. A 52 gravity naphtha is obtained. It is blended with pressure distillate for treating and rerunning, the bottoms being used for pressure still charging stock.

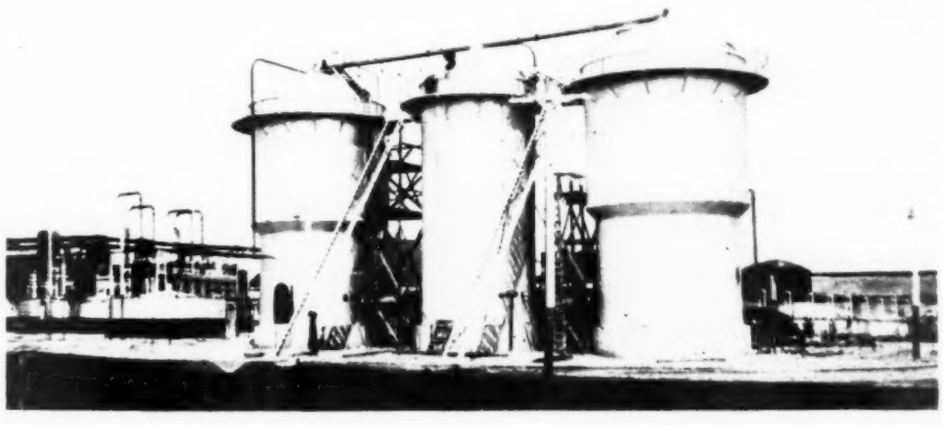
The cracking equipment is operated by the Standard Oil Co., and consists of three batteries of modified Burton stills. The stills are operated continuously. The heavy gas oil produced in the Continental refinery is cracked in four of these stills, capacity being about 1,500 barrels a day. One of the batteries cracks pressure distillate bottoms and is operated under 315 pounds pressure. These pressure stills apply heat through a bank of inclined tubes in the fire box. The still resemble a longitudinal drum water tube boiler. The vapors are roughly fractionated in hairpin towers, which consist of perforated plates from which small rods bent in hairpin shape are suspended to increase the surface of contact between vapors and descending liquid. The stills are operated on a 48-hour cycle. Part of the time pressure distillate bottoms is fed into the tower by means of a centrifugal pump. The gas from the unit is delivered to a gas recovery system in the Continental plant.

The continuous pressure stills operate in cycles of seven days. Cold charging stock is fed continuously while fuel oil residuum and pressure distillate are produced. Each still consists of a large drum above the fire box connected with headers to a bank of inclined tubes in the fire box. The vapors enter a bubble tower containing seven plates, each having a single aluminum bubble cap. Hot feed enters the side of the tower and condensate from the stream is refluxed over the top.

The distillate is received in accumulator drums and is then metered to the receiving tanks. A connection leaving the middle of the still drum and connected also with a line from the top of the drum leads the unvaporized part of the charge to a cone-bottom flash drum working at atmospheric pressure where the gas oil is flashed off and a fuel oil residue of eight to 12 degrees A. P. I. gravity remains to be pumped to storage. The flashed gas oil vapors pass into a bubble tower into which cold charging stock is being fed from the top. A light distillate stream is taken off the top of the bubble tower, and the heated charging stock containing condensed cycle stock is pumped to the top bubble tower.

Treating

The pressure distillate, together with the distillate from the coke still gas-oil, is treated with 59 degrees Be. sulphuric acid and recirculated sludge acid in a continuous treater. A steam heater is used to maintain the pressure distillate between 70 and 80 degrees F. From the heater the distillate passes through a water separator to settle moisture. The distillate is first treated with spent acid and then with the fresh 59 Be. acid, using 0.5 pounds fresh

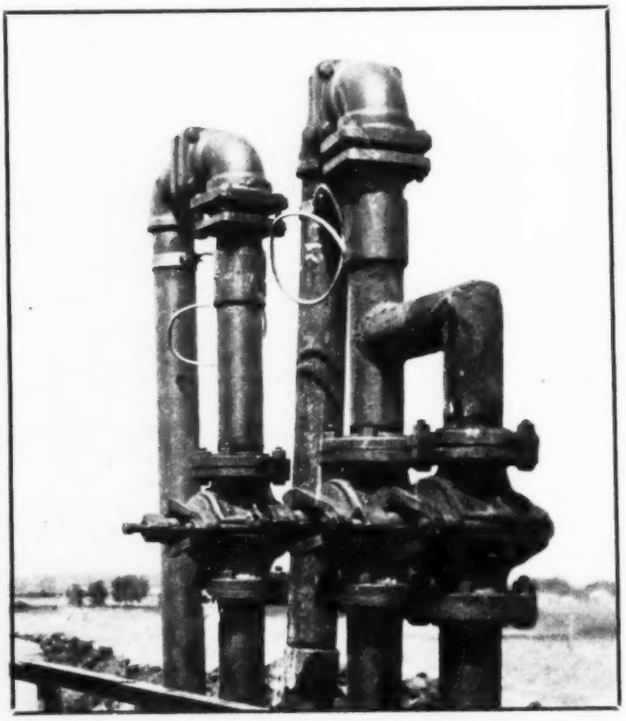


Treating agitators at the Glenrock plant.

acid per barrel. An orifice mixer and an eight-inch pipe filled with spiral tile is used to give contact.

The greater part of the acid sludge is settled in the first horizontal settler, 6 feet by 40 feet, from which the sludge is picked up by the acid circulating pump and returned to the orifice mixer. The fresh acid is fed into the suction of this pump from a blow case on which air pressure of 50 pounds is carried. Leaving the first acid settler, the distillate passes through a second drum of the same size for final settling. No attempt is made to save the acid sludge precipitated at this point. The distillate is now washed with water in an orifice mixer, and the water separated in a third 6 feet by 40 feet horizontal drum. A contact with eight to ten-degree caustic soda is next given in an orifice-mixed distillate and caustic flows to the first of three tanks used in treated pressure distillate service. Caustic is recirculated from the bottom of this tank and distillate flows from the top to the other two tanks before passing to the rerun still.

Raw gasoline from crude stills and pressure distillate rerun stills is sweetened in a continuous doctor treating plant. With a throughput of 150 barrels per hour, initial pump pressure is about 140 pounds. Fifteen to 17-degree doctor solution is mixed with the raw gasoline in an orifice mixer and then permitted to settle out in a 6 feet by 40 feet horizontal drum. Necessary sulphur is introduced ahead of doctor contact by bypassing a part of the raw gasoline through a drum containing roll sulphur. Control on sulphur is exercised by the treater through running copper strip tests on gasoline immediately following the doctor mixer. Following the doctor settler, two washes are given, settling being accomplished in 5 feet by 20 feet horizontal drums. Kerosene and Stoddard solvent are sweetened with doctor solution in a batch agitator.



Manifold on loading rack, showing ground wires.

Rerun Still

The pressure distillate is rerun in a 10 by 40 foot shell still equipped with a 15-plate bubble tower. The distillate is charged through a vapor heat exchanger and then a bottom heat exchanger. The feed is controlled by means of a rate volume control instrument. The vapor temperature is also controlled by means of recording control instrument on the reflux. The still has a capacity of 2,000 barrels per day of treated pressure distillate.

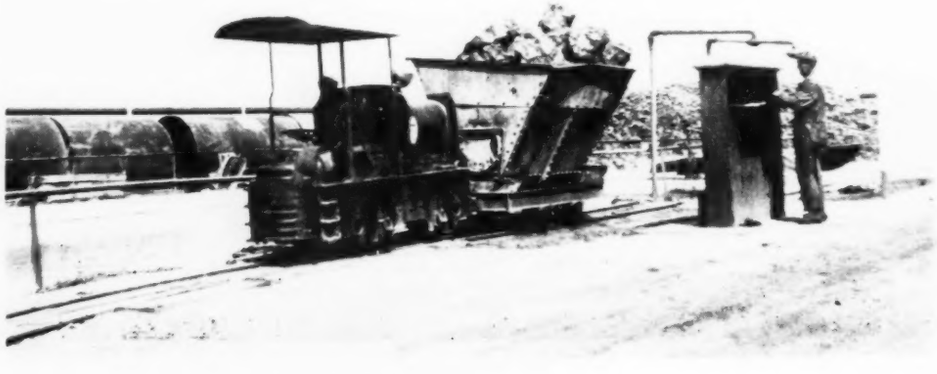
Vapor Recovery System

The vapors from the rerun and coke stills and from the pressure distillate run-down tank are collected by means of a 10 by 10-inch compressor. The compressor discharges into a pressure gas line from the vapor release drums on the pressure stills, and the line enters the absorption plant. The gas first enters the scrubber to remove hydrogen sulphide and then goes to an absorption tower containing bubble trays. Pressure distillate bottoms are used for absorption oil. The absorption system is operated under 15 pounds pressure. The distillation unit consists of a 6 by 40-foot shell still equipped with a fractionating column. The rich oil is forced through a heat exchanger against hot lean oil. From the heat exchanger it enters the center of the distillation column. The condensed raw gasoline is stored in 6 by 30-foot horizontal pressure drums enclosed in concrete and covered with earth. The absorption gasoline is sweetened with doctor solution.

The boiler house contains three 500-H. P. water tubular boilers. Each boiler is operated for two months before cleaning. The boiler feed water is treated by a hot process using lime and soda ash, and the addition of sodium aluminate as a coagulant. The treated water is filtered through sand filters. Exhaust steam heats the feed water to 200 degrees F. Water for the plant is obtained from the North Platte River, about one-fourth mile from the refinery. Requirements of 1,000 gallons per minute are supplied by one or more of three electrically-driven centrifugal pumps.

Ethyl Gasoline

An Ethyl blending plant was recently completed at the refinery adjacent to the loading rack, for blending Conoco Ethyl gasoline at this refinery. Ethyl fluid is received in cylinders at the plant.



Coke handling and quenching equipment.

Rapid Progress Shown *on* Texas Panhandle-Chicago Line

WORK is rapidly going forward on the various sections of the 24-inch gas line which is being built from the Texas Panhandle to Chicago by the Continental Construction Corporation of Kansas City, Missouri. The total length of the line, when completed, will be approximately 1,000 miles. The pipe is being welded into two- or three-joint sections and then coupled.

A total of 643 miles of the line has been awarded to date, and of this amount 333 miles are being welded. The pipe being used is fabricated in lengths of 30 to 40 feet, and the joint is plain end with inserted ring. The welded joints are made as shown in Figure 2. Pipe is lined up on rollers and, after tacking, the weld is put on in two beads.

The electric welding above mentioned has been sub-contracted to the Welding Engineering Company of Bartlesville, Oklahoma. The welds on this line are also produced with extraordinary speed. On this new line only 25 minutes are required to complete a joint with the welding process that is used on pipe with wall thicknesses of $\frac{5}{16}$ and $\frac{9}{32}$ inches.

Figure 3 shows a section of the line being constructed in Iowa. At this point the sections are composed of three pipe lengths between each coupling. The general contractor on this part of the line is Henry L. Lemons, Inc. Other general contractors on the line are Sheehan Pipe Line Construction Company and Bechtel Kaiser, Ltd.

Fig. 1. Operators and helpers welding lengths into sections.

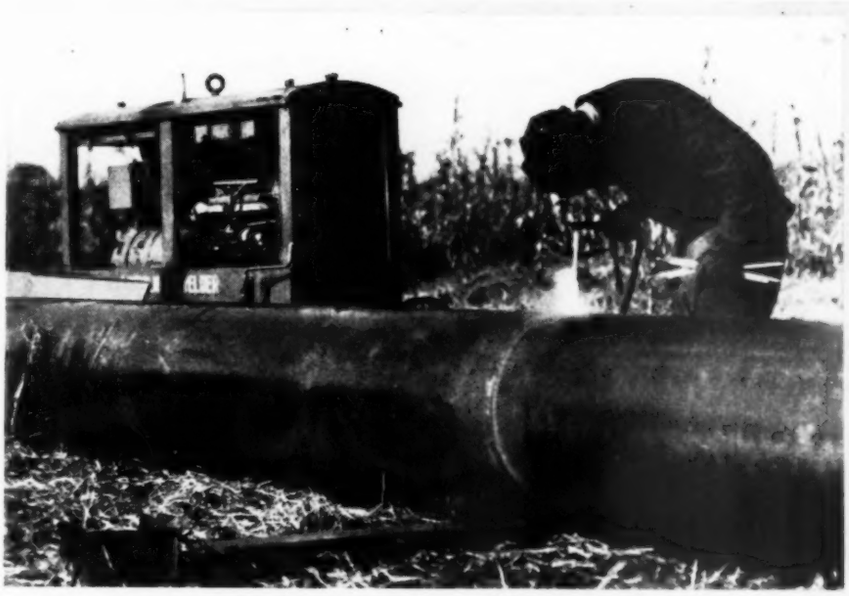
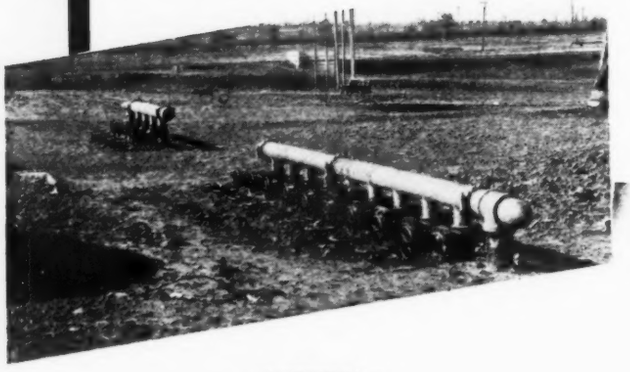


Fig. 2. Pipe on rollers to make it easier to turn for roll weld.

Fig. 3. Battery of welders working in the tall corn land of Iowa.

Standard Operating Practices

By WARREN



OPERATING practices, including drilling and producing methods, are standardized in the Van field, Van Zandt County, East Texas. All wells are drilled, completed, produced and equipped alike.

The pool, with the exception of a very few outlying tracts, is on a unitized block of acreage in which five major companies own an interest. These companies are the Pure Oil Company, which operates the properties, Shell Petroleum Corporation, The Texas Company, Sun Oil Company and the Humble Oil & Refining Company.

More than 200 wells have been drilled within the last 15 months and a revenue return almost equal to all expenditures has been realized, despite proration of production to an average of 200 barrels daily per well.

Very few oil properties in any field are kept so immaculate. After a well is completed all equipment, including the derrick and connections, are painted a light gray color, and all concrete painted white. The ground surface is leveled off, cleared of all debris, and harrowed. This presents a striking tone of neatness and is instrumental in removing many fire hazards.

When wells are finished in the Van townsite, the derrick is removed and all connections housed in a neat structure. Although the connections are housed, it is not necessary to enter the house to open or close the well, as this is done by means of a control arm operated from outside. Gas traps are not located at the well or near any buildings, but are situated at the stock tanks. This policy is employed to protect pedestrians and buildings from as much danger as possible.

All wells are drilled with rotary rigs and tools and are easily completed in 30 days, including rigging up, cementing of casing, and making up of flow connections. Formations penetrated offer comparatively easy drilling. They consist of sand, shale, sandy shale, lime and chalk. The

Top to bottom—A drilling rig. Manifold header at stock tanks. (Right) Cleanliness of field is shown in this picture.

Employed *in* Van Field

L. BAKER

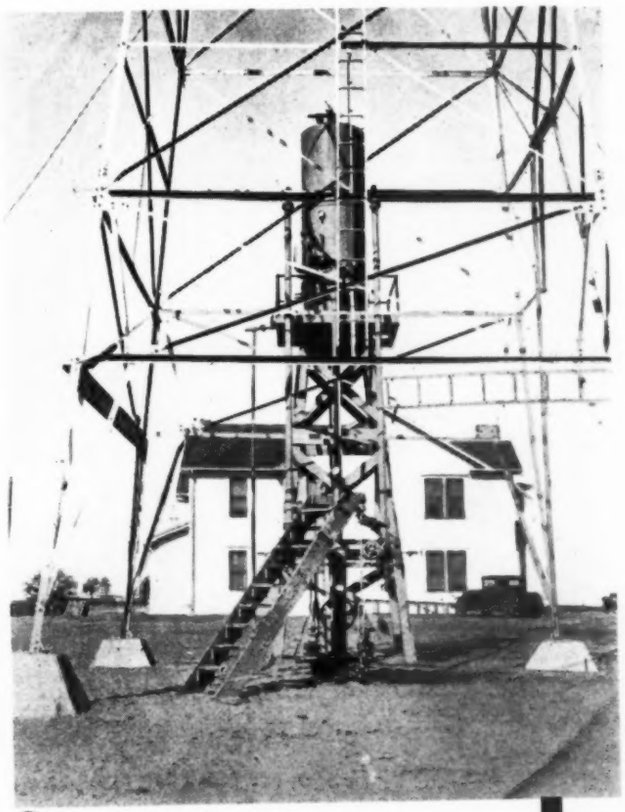
average producing depth at Van is 2,500 feet. Bottom hole pressures are about 1,250 pounds, with a tubing pressure of 400 pounds. Rotary drilling mud is maintained at 10 pounds for drilling and nine to nine and one-half pounds per gallon for drilling in.

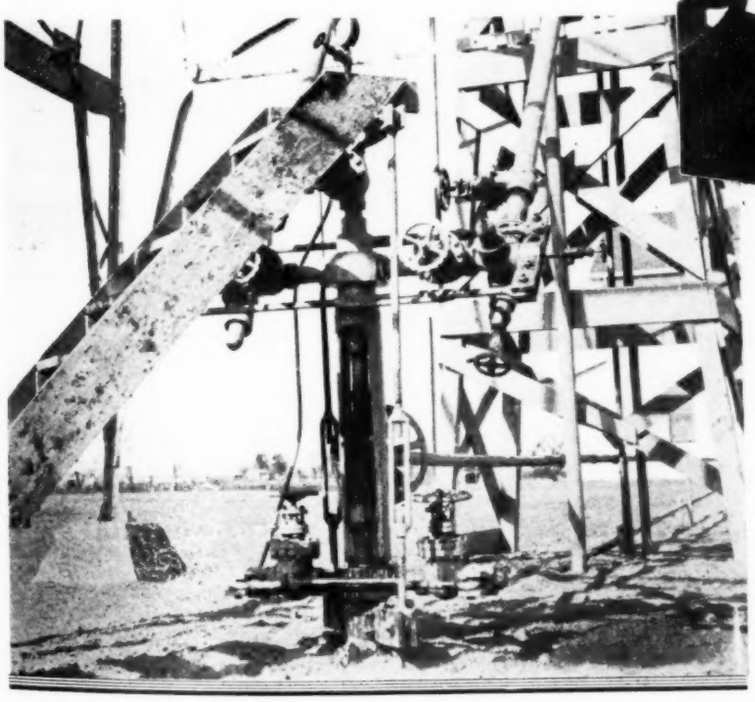
Drilling derricks in the field are of steel and 96 feet in height. The same derrick is used for producing, but the reinforcements are removed.

The surface pipe string is set deep enough to case off unconsolidated upper sands and shallow waters. This string is 10¾-inch, 32-pound casing set at 300 feet. It is cemented to the surface with 175 sacks of cement. The next string of casing is 7-inch O. D., A. P. I., 24-pound pipe, set in the top of the Woodbine producing horizon and cemented with 400 sacks of 16½-pound cement, which is allowed to set for four days. Coring operations are started in the Eagleford shale for contact with the Woodbine. It is important to know where the Woodbine has been reached in order to protect upper sands. All formation samples are tested at a field geological laboratory. As soon as it is certain that the Woodbine has been reached the last casing string is set.

Drilling contracts stipulate that the holes are not to vary over five feet from vertical. Measurements of the course of the hole are taken every 400 feet and when they are found to be over five feet from vertical must be straightened up before additional boring is done. This slows up drilling somewhat but assures the operators of straight holes in which little producing troubles will be encountered.

The producing horizon is drilled to a predetermined depth with rotary tools, after which all wells are completed through two and one-half inch tubing. A 3/16-inch liner long enough to lap into the casing is set on the bottom. After running the liner the hole is washed clean with clear water that is pumped down the tubing. The rotary mud





Top to bottom — A producing well showing separator hook-up. Close-up of nipple used in taking temperature of the oil. (Left) Close view of a producing hook-up.

is discharged through the annular space between the tubing and casing. Most of the wells come into production without swabbing after being washed.

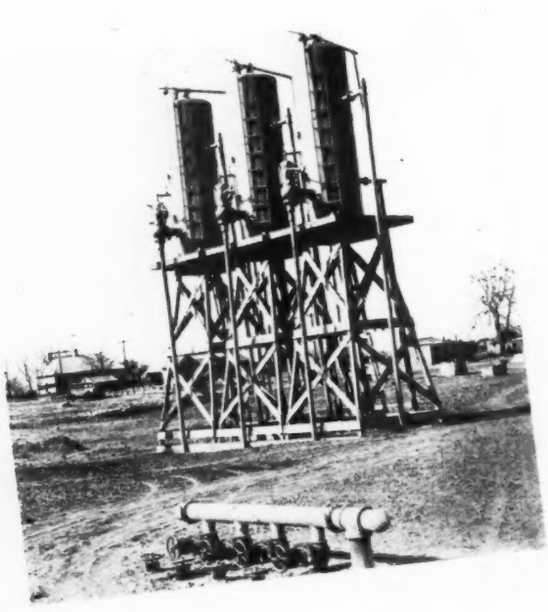
All wells are equipped with three-inch Christmas trees, 6⅝-inch, 2,500-pound test master gates, and a tubing head gate that permits retraction of tubing. This gate is operated by remote manual control. A two and one-half inch gate on a short six-inch pipe bradenheaded into the 10-inch casing is located just above the ground, which is the floor for all producing wells. This permits the cleaning out of wells through either the casing or tubing. An accompanying picture shows these gates.

Flow line gates are of three-inch, 2,500-pound construction. The hook-up has a positive bean type choke on the flow line on one side of the Christmas tree and a regulating choke on the other. The positive choke is used for taking all potential gauges and the regulating choke for controllin the prorated flow of the wells.

Before Christmas-tree connections are installed on a well they are first assembled at an assembly dock and tested with air pressure. The assembled hook-up is then carried intact to the well site and installed. All manifolds and other equipment set-ups are assembled and tested in like manner. The assembly dock is located adjacent to the company warehouse and is fitted with a crane for handling the equipment.

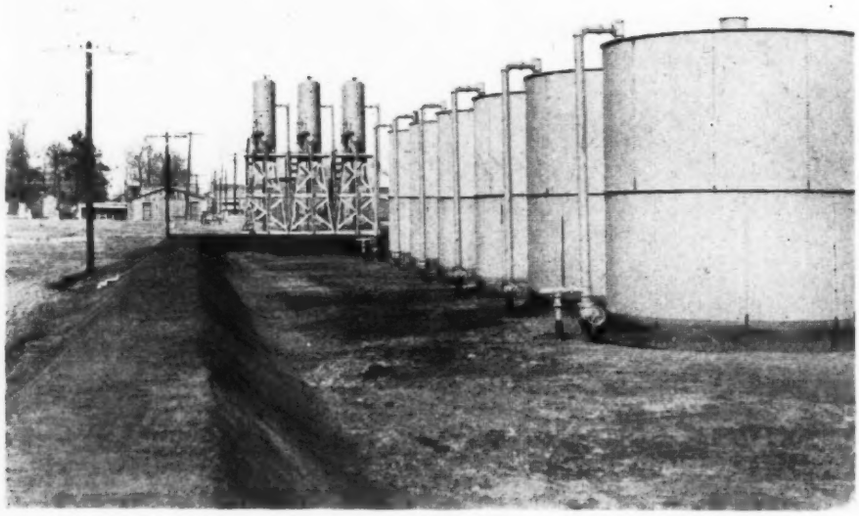
Producing hook-ups include pressure gauges, from which daily readings are taken on the tubing and casing pressures. Daily readings of the oil temperature are also made. Correct temperature readings are secured by means of a simple installation that does not permit the gas to expand and consequently lower the temperature. A small pipe is set and welded into a nipple that extends into the flow line. A small hole, large enough to hold a thermometer, is drilled in the projecting plugged end of this pipe. It is only necessary to lift the thermometer out and make a note of its reading.

Individual 4½ by 11-foot separators are used at all wells. These are set on pedestals of sufficient height to permit atmospheric pressures and still dump the oil into the tanks by gravity.



Above — Gas traps on townsite wells.

Above—A well in the Van townsite.



Stock tank battery.

Booster Station May Use Manual or Automatic Control

By J. H. DAMERON

WITHIN the past few years the trend in the construction of oil line booster stations has been toward simplicity of design, with the view of not only paring initial costs but also to lower operation and maintenance charges. In this comparatively short space of time have been witnessed many interesting and economical developments for the protection of stations against many hazards, affording more economical operation.

Last summer the Texas Empire Pipe Line Company started a construction program to increase its line capacity from 50,000 to 70,000 barrels daily through its 12-inch line from the Mid-Continent to the Great Lakes territory. The original stations on the line were built with reciprocating pump units and the stations were spaced approximately 80 miles apart except in one instance. To increase the capacity, motor-driven centrifugal pump stations were built half way between the original stations which were simultaneously increased in capacity.

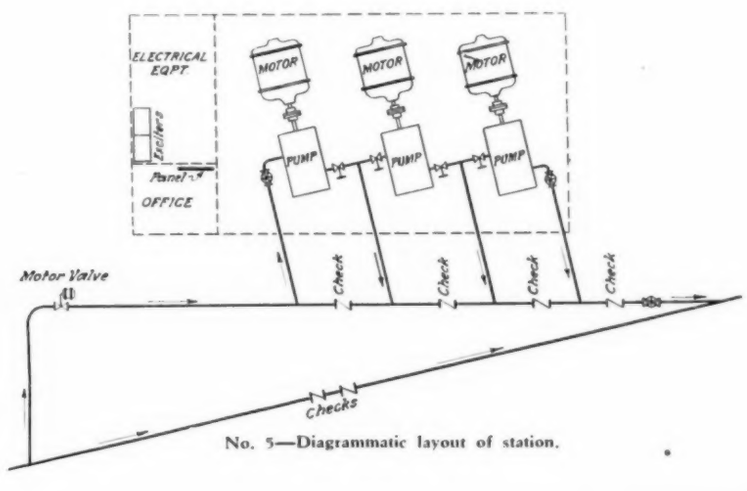
In design, the booster stations embrace numerous recent developments lending simplicity in construction and operation, making them easily adaptable to remote control. They are equipped with the most modern heating and lighting systems and are without station tankage or manifolds. As a result of the use of check valves and one motor-driven gate valve, the station operator can easily have the station on the line within five minutes and it is unnecessary to step outside of the station to get it into service. All of the stations are brick and tile in construction without a fire wall between the motors and pumps. All of the electrical equipment is housed in a walled off portion of the building which is subdivided by a steel wire cage separating the office (where the control panels are located), from the remainder of the electrical equipment such as exciters and main switches. Large windows have been built in the wall permitting the operator to look from the control panel in his office into the pump room.

Sand Springs station, located adjacent to the town of that name in Oklahoma, is representative of the booster stations on the line. In the pump room are three multiple-stage 1,800-r.p.m. line pumps, designed to deliver 3,035 barrels per hour against 368 pounds pressure. These are directly connected with a flexible coupling to three 800 horse power, 2,200-volt, 162-ampere, three-phase, 60-cycle, 1,800-r.p.m. synchronous motors. Two of the units will be used for operation and the third as a stand-by.

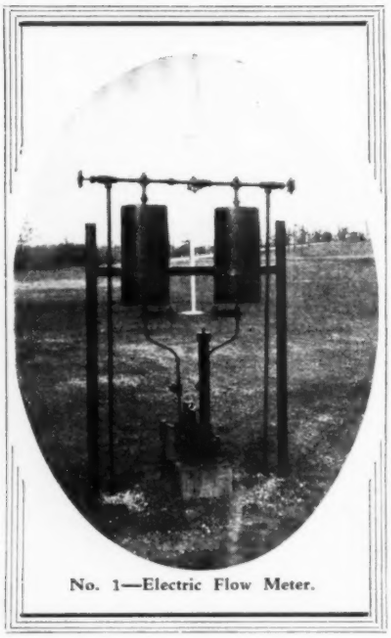
The three-panel control board is located against the wall in the office. It is a steel panel, so designed that the meters and switches for each motor are in a straight line up and down the board. In addition there is an etched plate of the station layout with a red light representing each motor, the motor-driven valve, the sump pump, and one of the main line pumps, which are lighted whenever any of these units are in operation. There are lights also for the ammeters and exciters and with these burning the operator has a picture directly in front of him showing what is in operation in and about the station.

A glance at an accompanying sketch will reveal the simplicity in operation. When the operator is given orders to start the station he first sets the switches for the operation of the units required and returns to the board where he starts the exciters. One of these is ample to handle both motors and the other was installed primarily as a spare unit. By pushing a button the motor-driven gate valve is opened in approximately one and one-half minutes. Simultaneously with this operation the button is pushed to start the motor on the No. 1 unit.

Prior to this, however, the suction and discharge valves on the pumps have been set with the former open and the latter cracked just enough so the disc is not tightly seated. Following the successive operations at the control



No. 5—Diagrammatic layout of station.



No. 1—Electric Flow Meter.

panel, the operator goes into the pump room to throttle the pumps with the discharge gate until the line pressure is regulated. When No. 1 unit gets in operation and is running smoothly, the electrical hook-up is so designed that No. 2 unit starts.

These two pumps operating in series will build up a pressure of approximately 800 pounds; and with a suction pressure of approximately 300 pounds at the station, which is utilized by the centrifugal units, the line pressure would leap to about 1,100 pounds when both units went on the line unless the pumps were throttled. Therefore, until the reciprocating pump station behind the booster station is regulated so its residual pressure is approximately 20 pounds, the booster units are throttled to reduce line pressure and prevent breaking the stream between the reciprocating pump station and the booster plant.

It requires approximately one hour for the stations to get "straightened out." When the additional unit at the reciprocating pump station is started to pump a greater volume, the by-pass valve on the triplex pump is opened and slowly closes to keep the discharge pressure between 700 and 750 pounds. The operator at the booster plant is guided in throttling the centrifugal pumps by watching the indicator suction and discharge indicator gauges on the board in the pump room.

Beneath each indicator gauge is a recording gauge which should show a steady decline in suction pressure until the stations are operating at desired pressures and then the line flattens out.

Just prior to operation the operator cracks each valve by turning the hand wheel a few turns and then turning it back so that the disc seats lightly. By doing this he eliminates considerable difficulty in opening the valves with pressure against them. Each valve is also tapped by a bleeder line, to relieve excessive pressure which might be built up in the body.

The flow of oil through the station is measured by an electrically operated flow meter which is located outside the station on the discharge line. The recorder for the meter is located on the gauge board in the pump room.

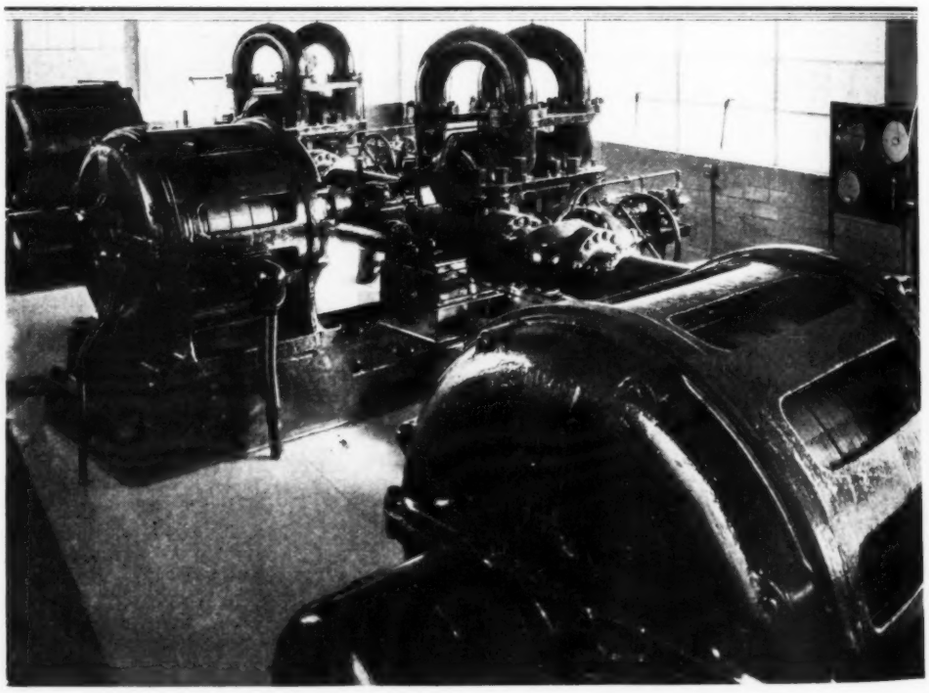
By referring to the sketch diagram of the station, it will be seen the layout not only brings the piping to a minimum, but places operation of the plant entirely in the station. The 12-inch motor-driven gate valve can be opened or closed by hand in the event of motor trouble on the valve or other emergencies. The check valves between the suction and discharge lines of each pump prevent the stream of oil going back into the suction lines. In throttling the pumps, of course, the oil which cannot pass through a partially closed discharge valve is churned inside the pump case.

Located on the station discharge line and close to the main line is a gate valve ahead of a check valve. This valve will be used only in the event the check valve fails to give a complete shut-off. Between the station suction and discharge lines are two check valves in the main line to prevent the oil stream from going back into the suction line when the station is in operation. Otherwise the valves are open. Two valves were put in to insure that a complete shut-off would be obtained.

When the pumping equipment was installed it was decided to stagger the pumps in relation to the floor plan to reduce friction losses by having the discharge connection of one unit go straight into the suction of the next. To assist in making connections and to relieve the rigid connections from transmitting vibration from one unit to another rubber ring type couplings were used to connect the long nipple with the flange welding neck and swage nipple. This type of connection is illustrated by an accompanying photograph.

The discharge of each pump goes through a 1,600-pound 8-inch valve, to which is welded an 8 by 10 swage nipple. The swage nipple is connected to the long nipple running to the suction of the next pump with a coupling. Another coupling is used to make the connection with the nipple to the welded flange nipple on the 1,600-pound 10-inch suction gate valve. Welded to the bottom center of the 10-inch nipple is a 10 by 12 swage going to the discharge line of the pump.

In addition to this protection to equipment, each valve is supported by a concrete pedestal. On top of the pedestal is an adjustable anchor, and by turning the bolts in it the



No. 2—General view of pump room.

valve is kept from hanging to the pump or nipple connection. Each valve was put in horizontally to make it easier for the operator to turn the hand wheels and lessen the possibility of accidents while opening a valve with pressure against it.

Lubrication of the outboard bearing on the pump is cared for by a stream of the fluid which the pump is handling and delivered to the bearing through a small line. All of the oil going to the bearing passes through a fine mesh strainer and the frequency of cleaning the strainer depends upon the foreign material in the oil being pumped. The lubricating lines are so connected that valves can be opened and closed to permit removal of one strainer for cleaning while the oil is passing through its companion.

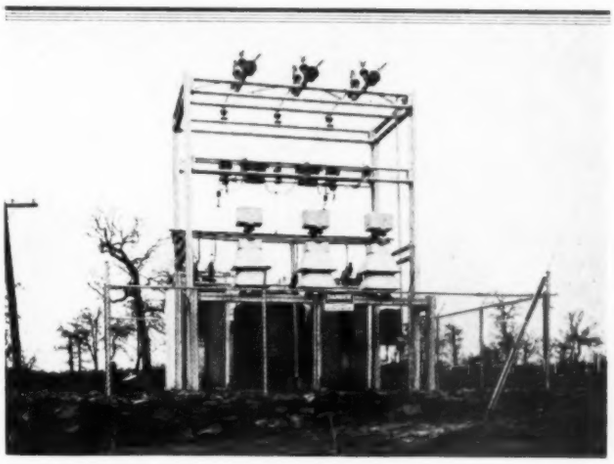
The thrust bearing is lubricated with oil, which is cooled by the oil handled by the pump. Small lines carry the cold crude oil around the container for the lubricating oil, cool it and carry it on into the pump's suction side. An indicating thermometer is installed on the top side of this bearing to permit the operator to keep close check on the temperature of the bearing. A sight glass and gauge cock are close by to permit checking the amount of lubricating oil in the bearing container.

The small amount of oil draining from various sources of the pump goes into the sump located outside the station. It is picked up by an automatically operated sump pump and discharged into the station's suction line. The motor-driven sump pump is started and stopped by the movement of floats in the sump.

The design of the station permits ample natural lighting, and lighting engineers designed the system so the artificial lights would not cast shadows in the station. The spacing of the units affords ample room to disassemble equipment for repairs and the units are so designed that the machinery may be taken down with relative ease. The floors are attractively painted and painted roofing material is used to make walkways to the points most frequently visited by the station operator.

The low pressure boiler for the heating plant is located in the warehouse adjacent to the pump station. Small radiators with fans behind them are located on the wall and suspended near the ceiling.

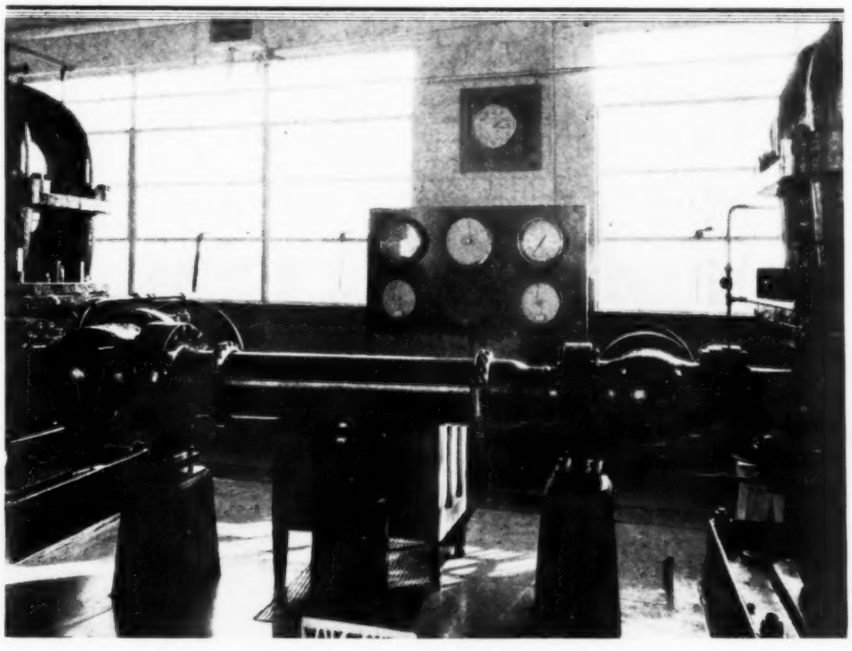
A minimum stock is carried in the warehouse and the walls have been utilized to make tool racks for all tools except small and frequently used ones, which are stored in a cabinet in the station. The telephones are located on a wall desk in the warehouse. When the station is called, the horn in the pump station is sounded and the operator walks a few steps to the warehouse where his conversation will not be interfered with by the noise in the station.



No. 3—Power sub-station.

Heat is not required in the warehouse, so in order that the operator will not have to make telephonic reports in a cold room a small opening was cut in the wall between the boiler room and the warehouse office. By opening a sliding door he can bring the instruments to the other side of the wall and make reports while standing in a warm room.

In the near future the station will be operated by remote control from a point 12 or 15 miles distant. It is so designed that the switch from manual to remote control may be made and give the station protection against the more common causes of shut downs. Protective devices will be installed to shut down the plant when it might possibly start pumping against a broken line. The motors are now protected against overloading by a circuit breaker and devices to protect the station and indicate the point of trouble will be installed for hot bearings, or other troubles.



No. 4—View of connection between suction and discharge of pumps and gauge board.

Wells Brought *in* Through Choke Nipples

By K. C. SCLATER

Top to bottom: Left—G. D. Gunn, connection foreman. Right—W. F. Beichner, farm boss. Both are with the Phillips Petroleum Co. in the Oklahoma City field.—Opening up a big well in the Oklahoma City field to take the allowable production. Great care is exercised and the well is opened up gradually to the amount required without putting undue strain on surface connections and trap equipment.—A close-up of the choke nipple installation on the Phillips Day No. 1 in the Oklahoma City field. Note the hand-wheel of the adjustable choke and the flexible joint between the steel cross and the 12½-inch flow line.

WHEN the Phillips Petroleum Company's well, Ciger No. 1 came in, it quickly acquired the reputation of being capable of producing more sand than any well in the Oklahoma City field. It is reported to have produced 2,284 barrels of oil, and 700 barrels of sand in 55 minutes while producing gas at the rate of 50 million cubic feet daily. Its prolific sand output became a source of grave concern and led the Phillips Petroleum Company production staff to cast about diligently for a better method of bringing in their wells in this area; a method that would reduce, if not entirely eliminate, sand cutting of casinghead connections and its attendant hazards.

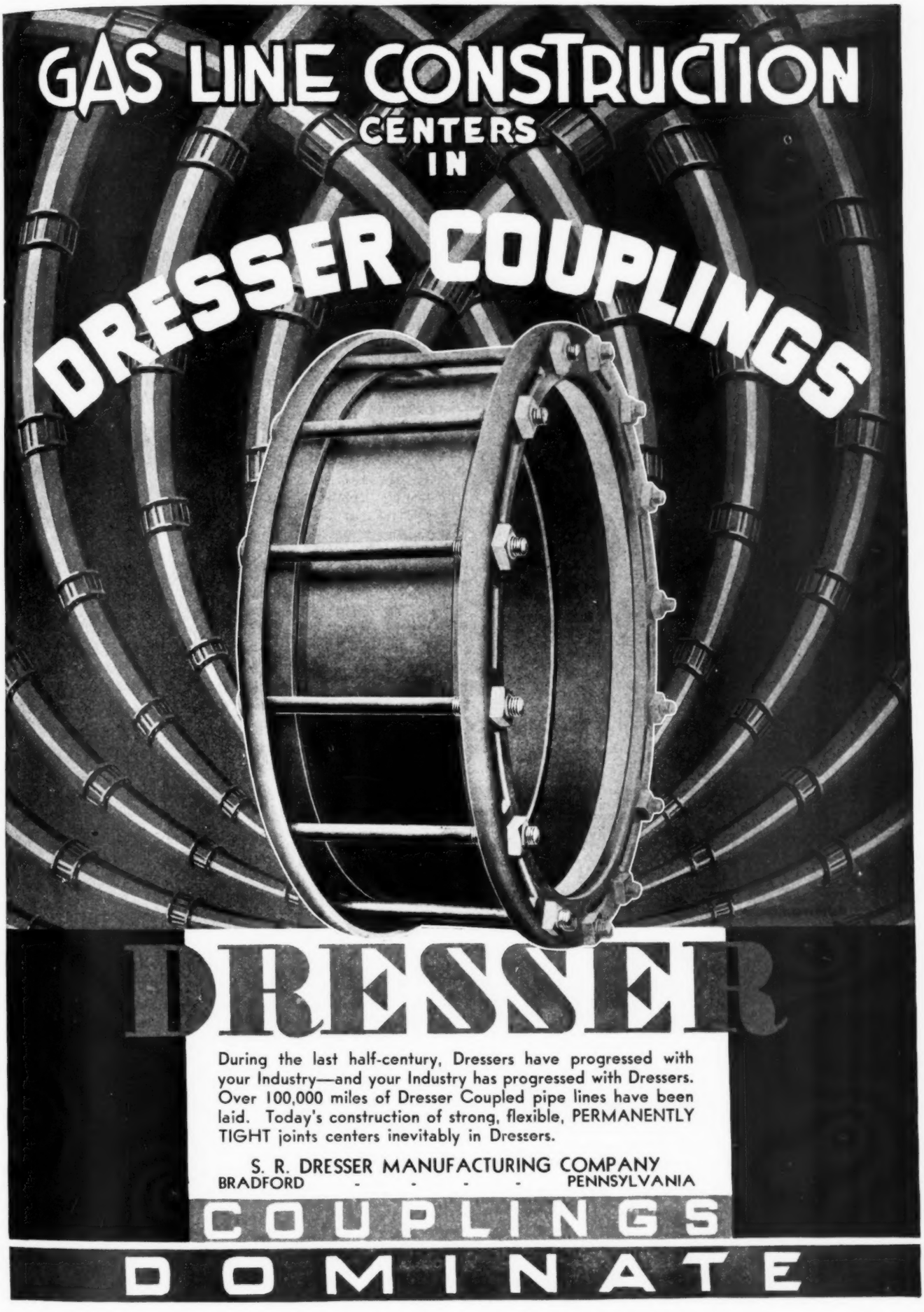
Long choke nipples at the casinghead and large size (12½-inch) flow lines between the choke nipple and the traps were given a trial. These proved so successful in alleviating the trouble from sand cutting that the method has been, or will be, adopted on all wells of the company in the Oklahoma City field. At this writing 15 wells are equipped with and producing through non-adjustable chokes, and three more through adjustable chokes. Incidentally, the use of chokes has proved an effective means of reducing gas-oil ratios.

Choke nipples were first used many years ago on wells for this very purpose, that of holding back sand in large flowing wells, though their adoption in the present instance for a like purpose is a departure from prevailing practice in the Oklahoma City field. By choking a well when it is brought in and restricting the rate of flow, the velocity is reduced and hence the sand-carrying power of the oil and gas issuing from the well.

Many wells in the Oklahoma City field where serious sand-cutting troubles occur, are equipped with vertical expansion chambers which are attached directly to the top of the well casing. As the oil and gas pass through the expansion chamber and into the flow line much of the cutting action of the sand-laden fluid is assumed to be dissipated against a floating baffle plate or other means inside the chamber.

Instead of the vertical expansion chamber on top of the well casing, the Phillips' method makes use of an extra large size flow line to the traps as an expansion chamber. Thus the chamber instead of being vertical is horizontal. The oil and gas enter the flow line through a choke nipple. A steel cross, 7-inch O. D. casing size, is screwed on top of the well casing. One side outlet of the steel cross is connected to the 12½-inch flow line by a flexible pipe coupling. To attach the 12½-inch flexible pipe coupling to the side outlet of the steel cross, a steel screw flange grooved on its outside edge to receive the coupling clamp is used. A hollow steel plug is screwed into the top outlet of the steel cross to take the impact of the sand-laden fluid in the casing. On the first well equipped, the Ciger No. 1, a three-inch choke nipple about two feet long is used. This is enlarged and threaded at one end to screw into the side outlet of the steel cross on the well casing. When in working position the choke nipple extends almost its entire length into the 12½-inch flow line. To facilitate making quick changes, two flexible pipe couplings are inserted in the flow line, thus forming a short removable section which will permit easy access to the choke nipple.

As soon as the favorable results obtained with the choke nipple and large flow lines were realized, all wells subsequently completed were brought in through chokes. Con-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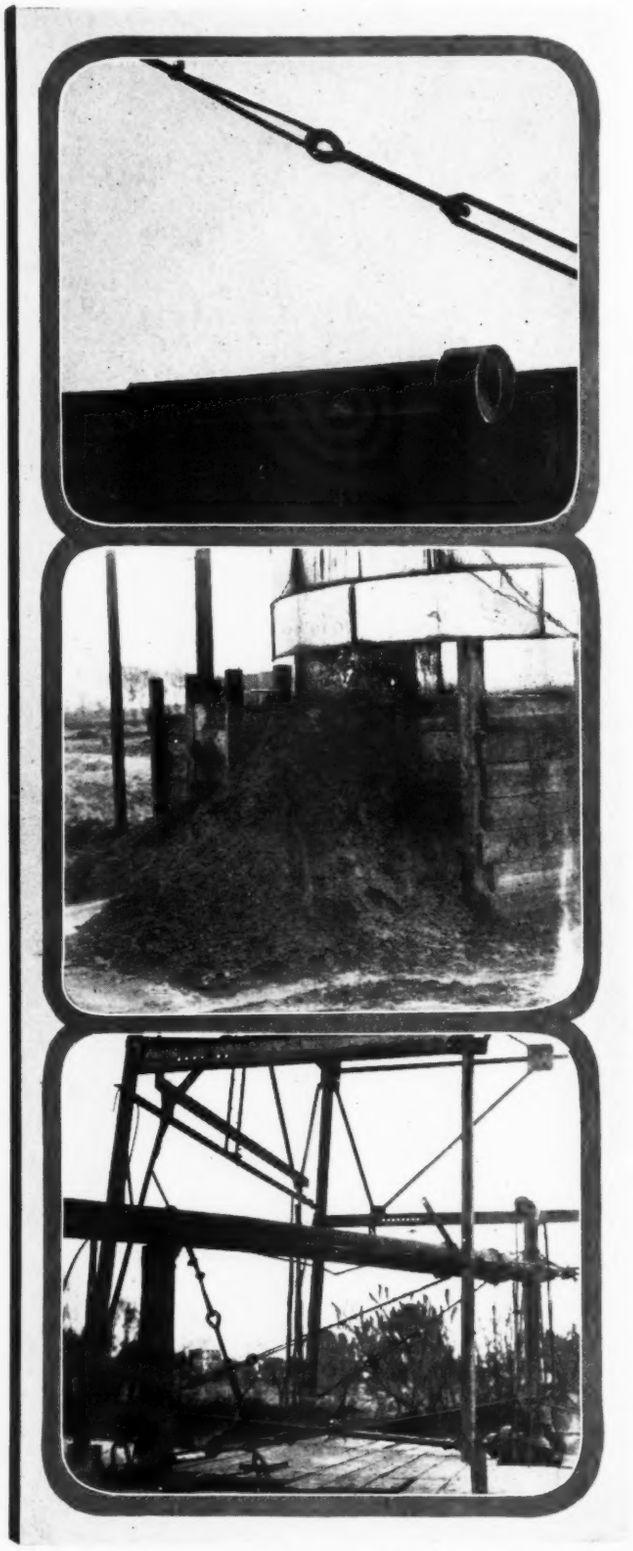
trol of the wells has been further improved by making the choke adjustable. The Ciger No. 1, from December 15, 1930, to about February 1, 1931, was produced through a non-adjustable choke. On the latter date an adjustable choke was installed, through which the well is now producing. Two more wells, the Roden No. 1, and the Day No. 1, have since been equipped with adjustable chokes.



Top to bottom—In the foreground is seen the choke used on the Phillips Ciger No. 1 well in the Oklahoma City field. It is about 2 feet long. Note the facing of hard metal on the upstream side of the choke nipple to combat sand-cutting.—The sand shown in the picture was produced by the Phillips Ciger No. 1 in the Oklahoma City field. This well has the reputation of being the greatest sand producer when it was brought in of all wells in the field.—One of the first of the Phillips wells in the Oklahoma City field, the Roden No. 1, to be equipped with the adjustable choke nipple for the elimination of sand-cutting trouble at the casinghead.

With the long (2-ft.) choke it has been found that the 12½-inch casing becomes sand-cut where the oil and gas emerge from the choke nipple on the downstream side. This trouble has been corrected, as possibility of damage to the flow line has been obviated by using a short length, about two feet, of 5½-inch drill pipe which screws into the side outlet of the steel cross in place of the long choke nipple. The upstream side of the drill pipe nipple is slightly tapered on the inside to receive a short choke nipple of special design about four inches long. Any desired size of choke can be quickly removed or replaced. By this arrangement all sand-cutting is confined to the drill pipe nipple which is of ample thickness to withstand long periods of such service without replacement. Only one flexible coupling is used in the flow line with this improved design. It is planned to equip all wells with this new type of hook-up.

With this improved design of choke much closer control of the well is possible and sand-cutting can be confined to the pipe nipple on the downstream side of the choke nipple.

It is found that with this type of hook-up the sand accumulates and becomes tightly packed in the hollow steel plug on top of the steel cross, probably the result of constant high velocity impact of the sand-laden fluids at the top of the casing. It appears that the absorption of this impact, together with the change in direction of flow in the steel cross and the restriction of flow by the choke nipple, the destructive cutting power of the sand is greatly dissipated.

Aside from the fact that sand-cutting trouble has been greatly reduced, a decided improvement in gas-oil ratios has been observed. Flowing open, the Ciger No. 1 produced at the rate of 2,250 barrels of oil an hour and 62 million cubic feet gas a day. With a 3-inch choke the rate of flow was 2,200 barrels an hour and 33 million cubic feet of gas a day. This is a reduction of approximately 50 per cent in gas production with a reduction of only about 2 per cent in oil production.

With a 4-inch choke the Roden No. 1 produced at the rate of 2,500 barrels oil an hour with a gas-oil ratio of 940 cubic feet per barrel. By reducing the size of choke to ¾-inch, the oil production was 300 barrels an hour and the gas-oil ratio 575 cubic feet per barrel. No open flow data on this well were available.

Similar results to those on the Roden No. 1 were obtained on the Day No. 1. With a 4-inch choke, the oil production was 2,500 barrels an hour and the gas-oil ratio 960 cubic feet per barrel. With a ¾-inch choke the oil production was 400 barrels an hour and the gas-oil ratio 630 cubic feet per barrel. No open flow figures were available on this well. Besides the reduction in gas-oil ratio on these wells an increase in the gravity (A. P. I.) of the oil was observed.

Another company has had good results by adopting the use of a choke nipple on one well. This well on open flow without a choke produced at the rate of 2,600 barrels an hour with a gas-oil ratio of 940 cubic feet per barrel. With a ½-inch choke the oil production was 160 barrels an hour and the gas-oil ratio 550 cubic feet per barrel. Also an increase of 1½ degrees gravity (A. P. I.) was obtained with the small choke.

With such convincing results and the fact that the hazards arising from sand-cutting have been greatly reduced there is no doubt regarding the soundness and the efficacy of the method.

L. B. Holland, superintendent for the Phillips Petroleum Company in the Oklahoma City field, modestly credits Don R. Knowlton, petroleum engineer, with suggesting and working out the details of the method.

Personal

Mr. S. B. Daugherty

WE HAVE still further strengthened our organization, particularily in the engineering division, by placing Mr. S. B. Daugherty in full charge of our development and research work.

Mr. Daugherty is well known to natural gas men as a designer, technical gas man and consulting engineer. His working years have been spent in designing gas compressors and in intimate contact with gas men and their problems.

He will be in complete charge of all development and research work ot this company, and will study the application of TRANSIT PUMPS and TRANSIT Gas ENGINES to the oil and gas industry to the end that these products will maintain, in the future, the leadership they have always enjoyed.

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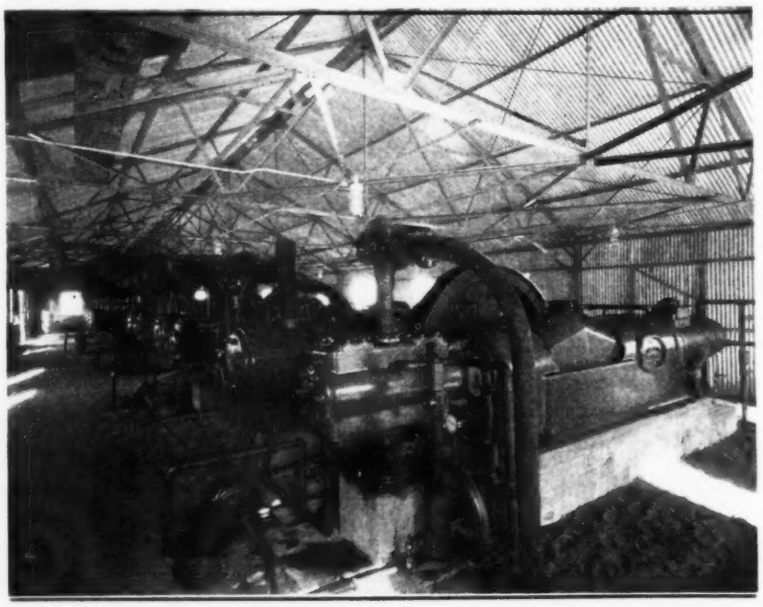
Repressuring Successfully *at* Burbank

By G. E. LONGFELLOW, *Dist. Supt., Skelly Oil Co., Shidler, Okla.*

A NUMBER of the companies operating in the Burbank field of Osage and Kay counties, Oklahoma, are experimenting with the object of increasing the ultimate oil recovery, efficiency in recovery, and conservation of gas. Repressuring in the Burbank field has affected only a small portion of the productive acreage and has been carried on mostly by the Phillips Petroleum Company, Carter Oil Company and Sinclair Oil & Gas Company.

On leases being repressured and on some adjoining ones, the production curves have flattened out and in a number of cases a good percentage of gain above normal production when repressuring was started has been shown. In general, the results of repressuring at Burbank have been marked by a gain above the natural decline.



A Modern Compressor Plant.

The application of repressuring or gas drive in this field is simplified by the fact that water invasion has given almost no trouble up to the present time. Water encroachment in the Burbank field is mainly from the west and northwest ends.

Usually, in this district, compressed residue gas from a gasoline plant has been employed for repressuring, but butane has been used in a few cases for injection purposes. Some wells have been switched from butane to residue gas after repressuring has been started.

A few companies are now observing the effect on gas and oil production of different back pressures on the direct offsets. On one of the Carter Oil Company's leases meters have been installed at eight wells on the lease boundaries, two locations from the key wells, for recording purposes.

Most companies repressuring install meters to measure the injected gas and adopt manual controls on wells that show any tendency to channel. The controls aid in the prevention of channeling by putting back pressure on the offending wells. In some cases, but not all, meters have been installed for measuring the amount of wet gas going to the gasoline plants.

Both old wells and holes specially drilled have been used with success as the input wells. When a special well is drilled it is usually a "five-spot" location. Often these wells are cored and the formation studied before equipping the well for injection purposes.

In equipping an injection well, a packer is set above the producing sand, and the well tubed, generally with two-inch diameter tubing.

An exception to the use of residue gas direct from gasoline plants for repressuring is that of the Carter Oil Company on the J. A. Moore and C. E. Bait farms in Section 9-26-6e. The equipment here consists of two 80-horsepower units; one with 6¼ by 20 inch and the other with 13½ by 20 inch compressor cylinders. The plant is located on the site of the abandoned Burbank gas booster station, and the blocks for the machinery were already in place. The installation was made with the object of supplying gas to any lease that might need it, and the capacity is about 750,000 cubic feet per day, at a discharge pressure of 150 pounds from residue gas obtained at the gasoline plant at 20 pounds pressure. The gasoline department owns and operates this plant and the leases receiving the gas are charged a price per thousand cubic feet, based as nearly as possible on the actual cost.

Incoming gas treated at the Burbank gasoline plant of the Carter Oil Company is measured by master meters at the plant and not from individual leases, and there is no method of determining exactly what enrichment of gas as a whole has been effected on several leases.

The Carter Oil Company started repressuring on the F. D. Allen farm in Section 16-26-6e, and repressured to 320 pounds in September, 1926. The total gain in production since starting to repressure has been 74,478 barrels. The total gas injected has been 449,763,000 cubic feet; an average volume of gas injected ber barrel of oil gained to January, 1930, of 6,039 cubic feet.

The gas from four individual wells offsetting the input well was measured during the period from September 1st, 1926, to October 14th, 1929. The total amount injected in 1926 was 25,179,000 cubic feet, and that produced from the four wells, 19,568,000 cubic feet. In four months of 1927 127,323,000 cubic feet of gas was injected, during which period the four wells produced 96,932 cubic feet.

On the Carter Oil Company's Moore farm no special preparation was given the well selected for input purposes, except for cleaning out and the installing of new two-inch tubing set at 2,837 feet, with a packer at 2,616 feet. The initial production of this well was 622 barrels after a five-

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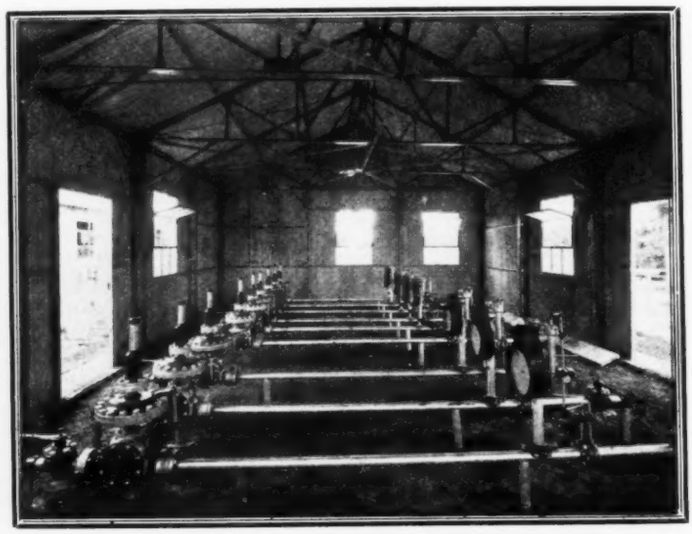
quart shot between 2,827-37 feet. Injection of gas is controlled by a gate valve which was adjusted to pass 200,000 cubic feet per day at a pressure of 150 pounds, although the pressure has since declined to 90 pounds where it now remains. This input well is located in the northwest corner of the lease and gas and oil production from the leases to the west, northwest and north have been observed. Gas volumes are small, ranging from 10 to 70 thousand cubic feet per day per well and runs 3,500 cubic feet per barrel of oil produced. Test gauges of oil production from separate wells are being made for accurate observation of possible changes.

The Moore farm station is also supplying gas to the Bait and B. Morris farms. The injection well on the Bait farm is receiving 100,000 cubic feet per day at a pressure of 90 pounds. Two input wells on the B. Morris farm are old producers that have been converted into pressure wells.

The Sinclair Oil & Gas Company has used only old wells for injection and have secured good results, normal decline having been stopped, and in some instances a marked gain in production shown. Residue gas is used by this company. Repressuring was started by the company in the northwest quarter of Section 32-27-6 on March 30th, 1927. The injection pressure was 105 pounds; production on January 6th, 1930, was 50 barrels and on November 11th was 48 barrels, showing very little decline for 1930.



Compressor Plant Meter House.

Residue gas from the Sinclair gasoline plant at Shidler is being used for this company's repressuring work. Meters are installed to measure the injected gas and manual control is resorted to on wells that show a tendency to channel.

Residue gas is being used by the Phillips Petroleum Company for repressuring work, with a few exceptions, and the exceptional cases are due to a surplus of the lighter fractions from the gasoline plant that were formerly wasted or blown into the air. Gas is furnished at the required pressure from compressor units already installed in the field by the gasoline department. Gas is metered on injection and each lease is equipped with a meter for wet gas to the plant, furnishing a fairly accurate record of the returns. Regulators are installed where necessary to hold back pressure to prevent or control channeling.

Oil production was first found in this field in 1920 and active development continued until the latter part of the year 1926. The peak production was reached in July, 1923, when production was 121,760 barrels per day. The initial production per well was from 50 to 5,000 barrels. Up to the end of the year 1929 the field had produced 163,761,455 barrels of oil, an average of 7,676 barrels per acre, though some leases have produced three times that much. There are now 2,135 wells in the field with a total daily production of 14,000 barrels daily. Gravity of the Burbank oil at the time of flush production was from 37 to 39.9 degrees and at present is from 36 to 39 Be.

Though dry gas wells have not been frequent at Burbank, several were completed near the central and western central portions of the field from 1920 to 1922. Rock pressures were from 500 to 900 pounds per square inch and the daily open flow capacity from three million to twelve million cubic feet. The average initial rock pressure for the field was about 800 pounds.

In most sections of the field there is a blue shale bed from a few inches to three feet in thickness about 50 feet above the Burbank sand, with a dry gas sand as much as 30 feet in thickness above. In some places in the field this sand was not logged and possibly is absent.

Structurally the field is an undulating monocline, with an impervious shale barrier on the north and east, forming a closure on the east side. The dip is 35 feet to the mile in a westerly direction.

The depth to the producing sand ranges from 2,700 feet in the southeast to 3,200 feet in the northwest end of the field. This sand is known as the Burbank formation, and is near the base of the Pennsylvania. The sand is fine grained, siliceous with calcareous cementation and from 25 to 100 feet in thickness.

Porosity of the Burbank sand is affected by tightly cemented streaks dividing the sand into two or three producing horizons. The largest initial production and probably the greatest ultimate recovery from wells in this field will be from those in which the porosity percentage of the sand is the largest.

Melcher determined the porosity of the Burbank sand to be from 13⅞ to 32⅞ per cent with an average of 20 per cent and that apparently at the lower point little or no oil and gas was in the sand. The highest point on the structure is in Section 9-26-6e and the best production from wells four or five miles to the northwest where the producing horizon is from 100 to 150 feet lower on the structure, and the sand more porous and permeable.

PHILLIPS PETROLEUM COMPANY OPERATIONS

No. Input Wells	Location	Operations Commenced	Amount Pressure (Pounds)	Old Prod. (Bbls.)	Present Prod. (Bbls.)
2	NE 11-27-5	5-4-30	50	227	211
3	SE 11-27-5	2-16-29	50-170	220	210
4	NE 12-27-5	2-23-29	150	112	110
3	NW 12-27-5	1-11-29	62	130	122
2	NW 23-27-5	8-24-29	20	220	214
1	SW 12-27-5	3-9-30	70	190	197
1	NW 14-27-5	4-20-29	80	46	67
1	SE 10-27-5	5-8-30	170	190	200
2	SW 1-27-5	3-19-29	170-240	150	128
2	SW 11-27-5	3-11-30	20	105	128
2	SE 2-27-5	1-3-29	190	95	110

PHILLIPS-SKELLY COMPANIES OPERATIONS

No. Input Wells	Location	Operations Commenced	Amount Pressure (Pounds)	Old Prod. (Bbls.)	Present Prod. (Bbls.)
1	SW 24-27-5	2-18-30	90	29	45
1	NE 26-27-5	2-16-30	60	106	105
1	NE 25-27-5	7-13-30	100	61	57
1	SE 23-27-5	2-10-30	70	61	70
1	NW 25-27-5	5-14-29	180	12	48
1	SE 26-27-5	7-1-30	60	55	53

SINCLAIR OIL & GAS COMPANY OPERATIONS

No. Input Wells	Location	Operations Commenced	Amount Pressure (Pounds)	Old Prod. (Bbls.)	Present Prod. (Bbls.)
1	SW 29-27-6	4-30-30	118	89	74
1	SW 20-27-6	5-25-28	95	70	65
1	SW 29-27-6	4-3-28	135	41	74
1	SW 36-27-5	8-25-28	20	90	75
1	NE 15-27-5	8-15-28	22	92	75

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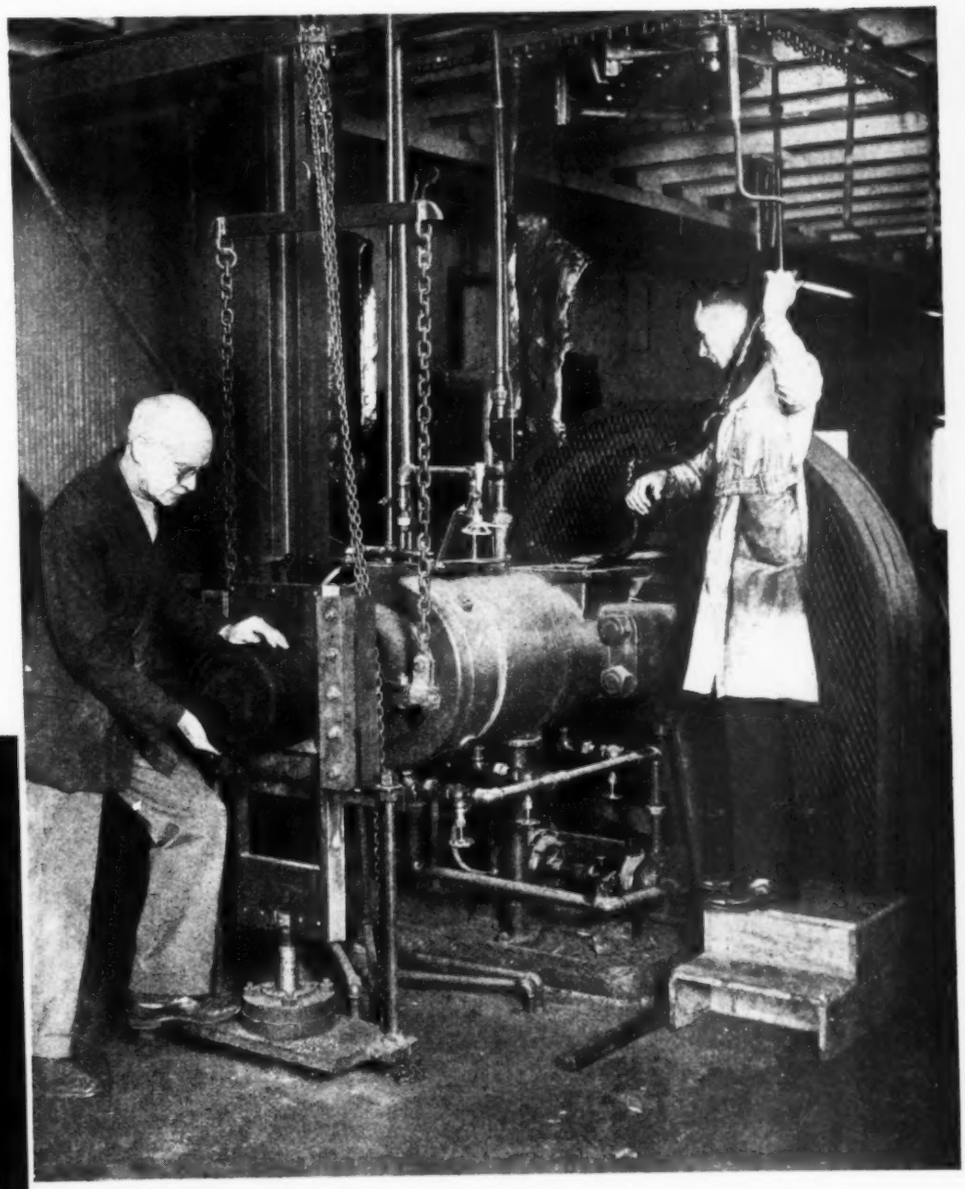

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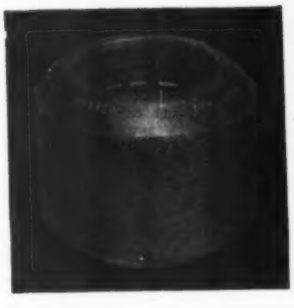

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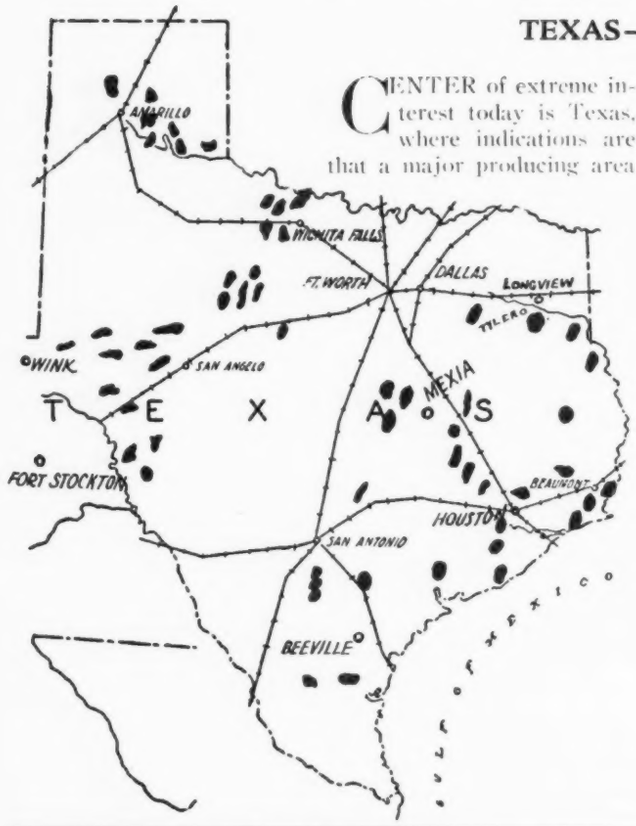
Latest Activities *in the* Oil Fields*

TEXAS— Production, 1930—290,720,000 Barrels



CENTER of extreme interest today is Texas, where indications are that a major producing area has been opened in the eastern part. Activity in the state as a result is increasing. A real oil boom is under way in Gregg and Rusk counties and new locations and completions are being made daily.

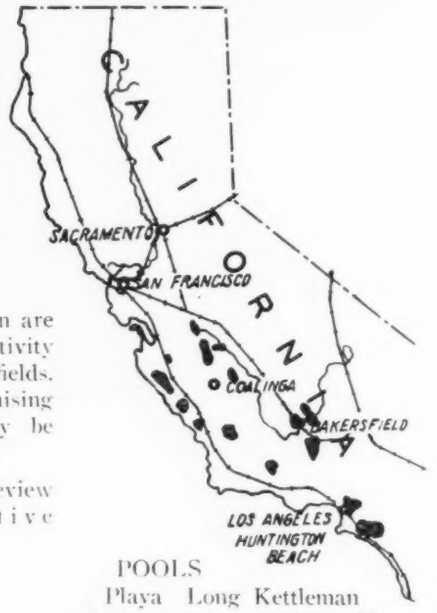
During February the state had 324 permits for drilling, 313 completions, 105 rigs and 710 drilling wells. Both rotary and cable tools operate in this state.

A review of the state's active fields is as follows:

	POOLS			
	East Texas	Gray County	Van	Refugio
Number of Permits	59	6	12	2
February Completions	16	13	14	11
Number of Rigs	71	15	3	2
Number of Drilling Wells	70	20	21	30
Gravity of Oil	40	42	36	26
Depth of Production	3600	2900	2600	6500
Type of Tool Used	Rotary	Rotary	Rotary	Rotary
Number of Casing Strings	2	2	2	3

CALIFORNIA

Production, 1930—228,612,000 Barrels



There were 319 drilling wells in California last month and 27 rigs. The state had 21 permits granted for drilling and 52 completions. Heavy restrictions on drilling and proration of production are holding down activity in the California fields. Several very promising areas could easily be drilled if desired.

Following is a review of the state's active fields:

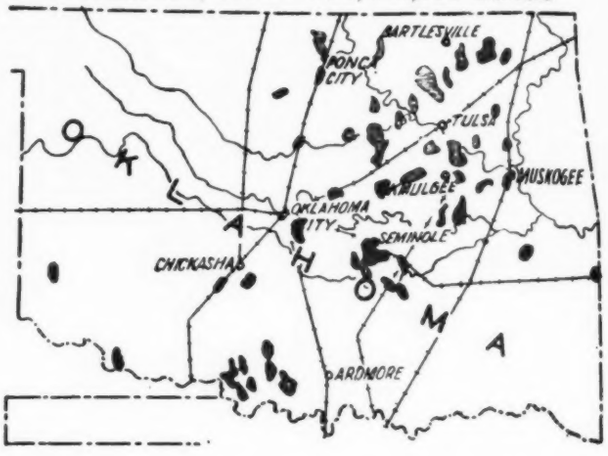
	POOLS			
	Playa Del Rey	Long Beach	Kettleman Hills	Ventura
Number of Permits	4	1	1	—
February Completions	15	14	1	2
Number of Rigs	4	2	—	1
Drilling Wells	31	49	15	29
Depth of Production	6000	7000	8300	7800
Gravity of Oil	23	26	60	36
Type of Tool Used	Rotary	Rotary	Rotary	Rotary

*All statistics as of March 1st.

C Denotes oil and gas fields.

OKLAHOMA

Production, 1930—214,425,000 Barrels



Activity in Oklahoma continues to decline sharply. At present there is no real competitive drilling campaign in the state, outside of those still drilling at Oklahoma City.

A summary of Oklahoma and the Oklahoma City field operations for the past 30 days is as follows:

	Entire State	Oklahoma City
Number of Permits	94	20
February Completions	107	38
Number of Rigs	67	7
Number Drilling Wells	201	58
Gravity of Oil	36	39
Depth of Production	Varies	6400
Type of Tool Used	Cab.-Rot.	Rotary
Number of Casing Strings	Varies	3

The gravity of the oil varies in the state, but averages 36 degrees A. P. I.

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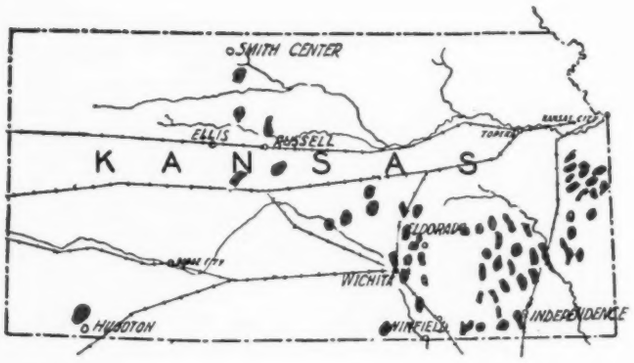
KANSAS—Production, 1930—41,745,000 Barrels



There were 56 rigs and 86 drilling wells in the state of Kansas last month. During the same period, 51 permits for drilling were issued and 27 wells were completed. Both cable and rotary tools are used in the state, with the former predominating.

Following is a survey of the active spots in the state:

	POOLS		
	Sedgewick County	McPherson County	Hugoton Field
Number of Permits	7	20	8
February Completions	7	10	1
Number of Rigs	2	17	5
Number Drilling Wells	8	32	9
Gravity of Oil	36	37	gas
Depth of Production	2900-3250	2900-3400	2750
Type of Tool Used	Cab.-Rot.	Cab.-Rot.	Cab.-Rot.
Number of Casing Strings	2	2	2

ARKANSAS

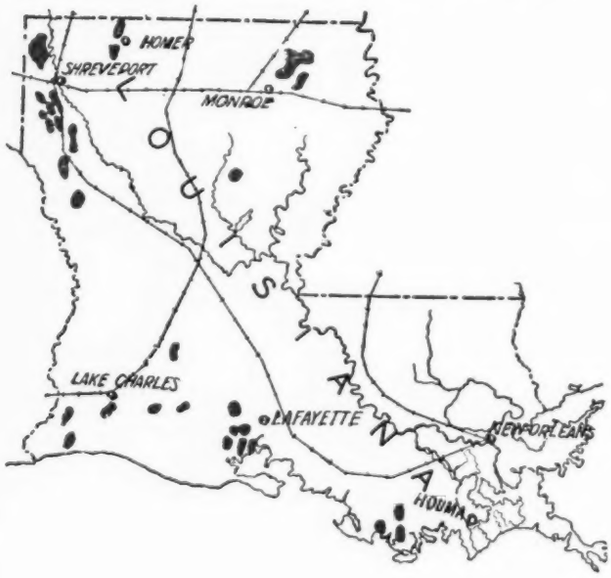
Production, 1930—19,680,000 Barrels

Arkansas activity during the past month was as follows: 8 permits for drilling, 16 completions, 12 rigs and 36 drilling wells.

Frequent heavy gas pressures and soft, cavey formations are penetrated in reaching the producing horizons in this state. Rotary tools are used for drilling the oil wells.

LOUISIANA

Production, 1930—23,150,000 Barrels



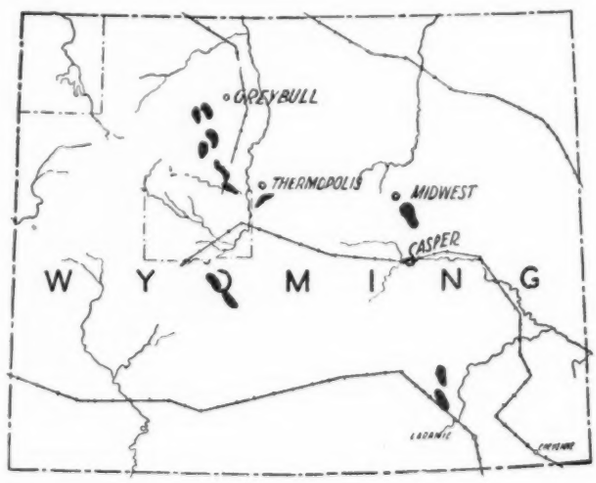
There were 31 new permits for drilling granted in Louisiana last month, when the state had 54 completions, 35 rigs and 114 drilling wells. Rotary tools are used for drilling operations.

In Mississippi, adjoining Louisiana to the east, had 4 completions. The state has 7 rigs and 24 drilling wells. Operations in this state are centered around Jackson, where several gas fields have been discovered.

WYOMING

Production, 1930—11,177,000 Barrels

The state of Wyoming had 6 completions, 17 rigs and 96 drilling wells. Both rotary and cable tools are employed in this district for making hole, with cable tools the most common.



● Denotes oil and gas fields.

NEW YORK

Production, 1930—3,825,000 Barrels

PENNSYLVANIA

Production, 1930—12,810,000 Barrels

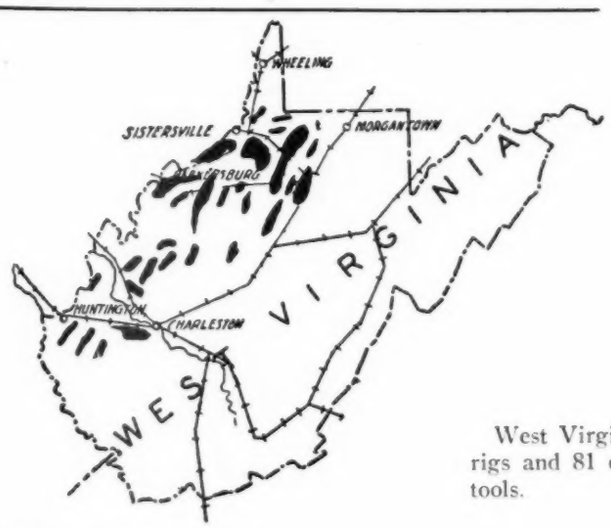
There were 42 tests completed in Pennsylvania during the last 30 days. At that time figures for the state showed 9 rigs and 50 drilling wells. New York, adjoining Pennsylvania on the north, had five completions during the same period.

Cable tools are employed for drilling in both of these states.

ILLINOIS

Production, 1930—5,695,000 Barrels

A total of 6 wells were completed in Illinois during the month of February, during which time 3 new rigs were erected. There are a total of 20 drilling tests in the state. Drilling operations are carried on with cable tools. The producing depths are shallow and no unusually hard formations are encountered.



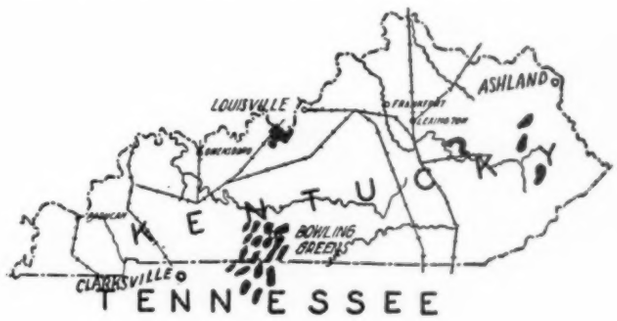
● Denotes oil and gas fields.

KENTUCKY

Production, 1930—7,360,000 Barrels

The state of Kentucky had 145 drilling wells, 6 rigs, and 24 completions. Tennessee reported 1 completion, no rigs and 15 drilling wells.

Drilling in both states is done with standard tools.



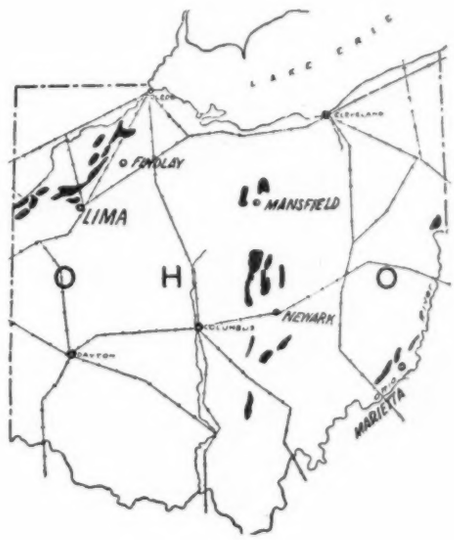
TENNESSEE

Production, 1930—20,000 Barrels

OHIO

Production, 1930—6,525,000 Barrels

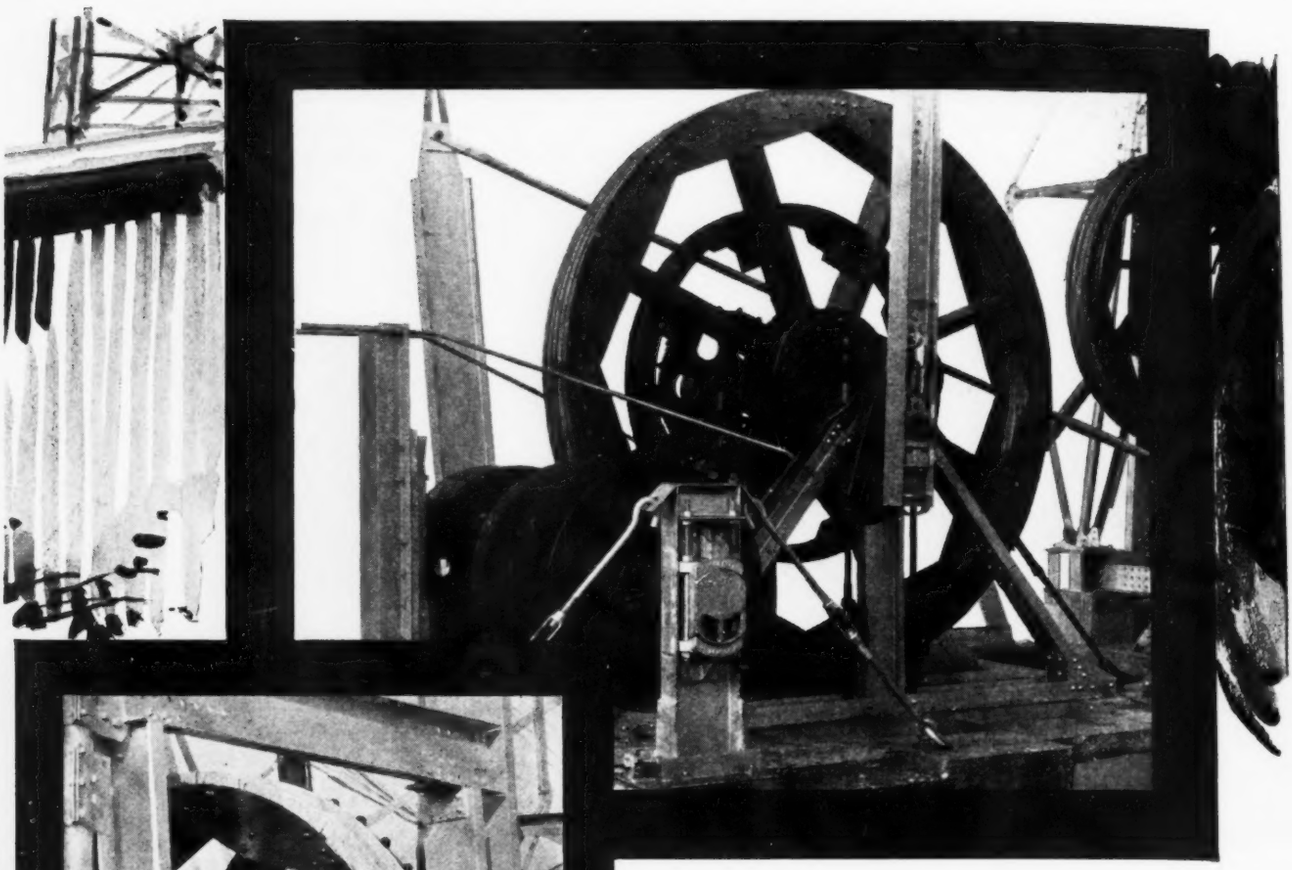
Activity in Ohio is increasing, while other states in the central division are declining. This state had 106 completions last month, and had 54 rigs and 190 drilling wells. Cable tools are employed for drilling all wells in this region.

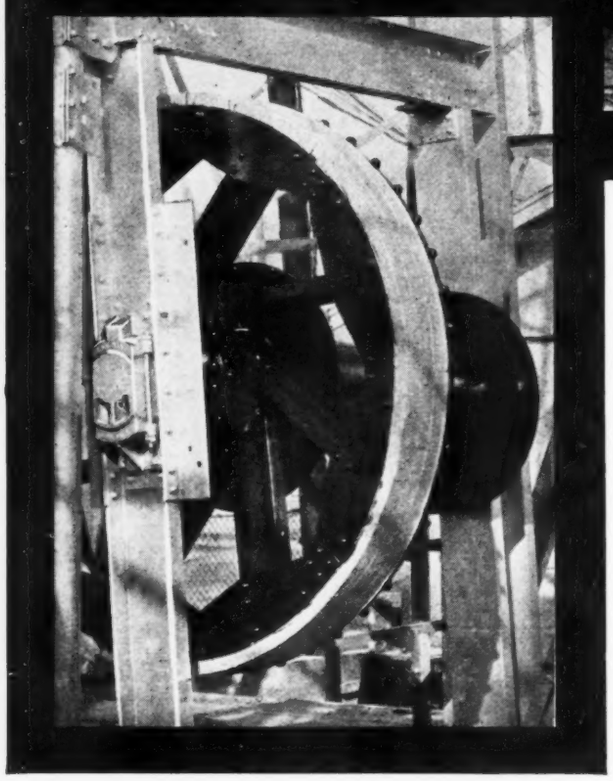


WEST VIRGINIA

Production, 1930—5,100,000 Barrels

West Virginia had a total of 37 completions last month, and showed 20 rigs and 81 drilling wells. Wells in this locality are drilled with cable tools.





Upper illustration shows the Moore self-aligning pitman bearing in position on the wrist pin, also the self-aligning tail post bearing on the friction sand reel, assuring free, smooth running.

Lower illustration shows the Moore calf wheel post self-aligning bearing, showing oil reservoir on top for easy lubrication.

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An outstanding feature of Moore equipment is the Moore self-aligning bearing. Unusual and unexpected drilling conditions have made it highly important to develop a device so flexible, efficient and fool-proof.

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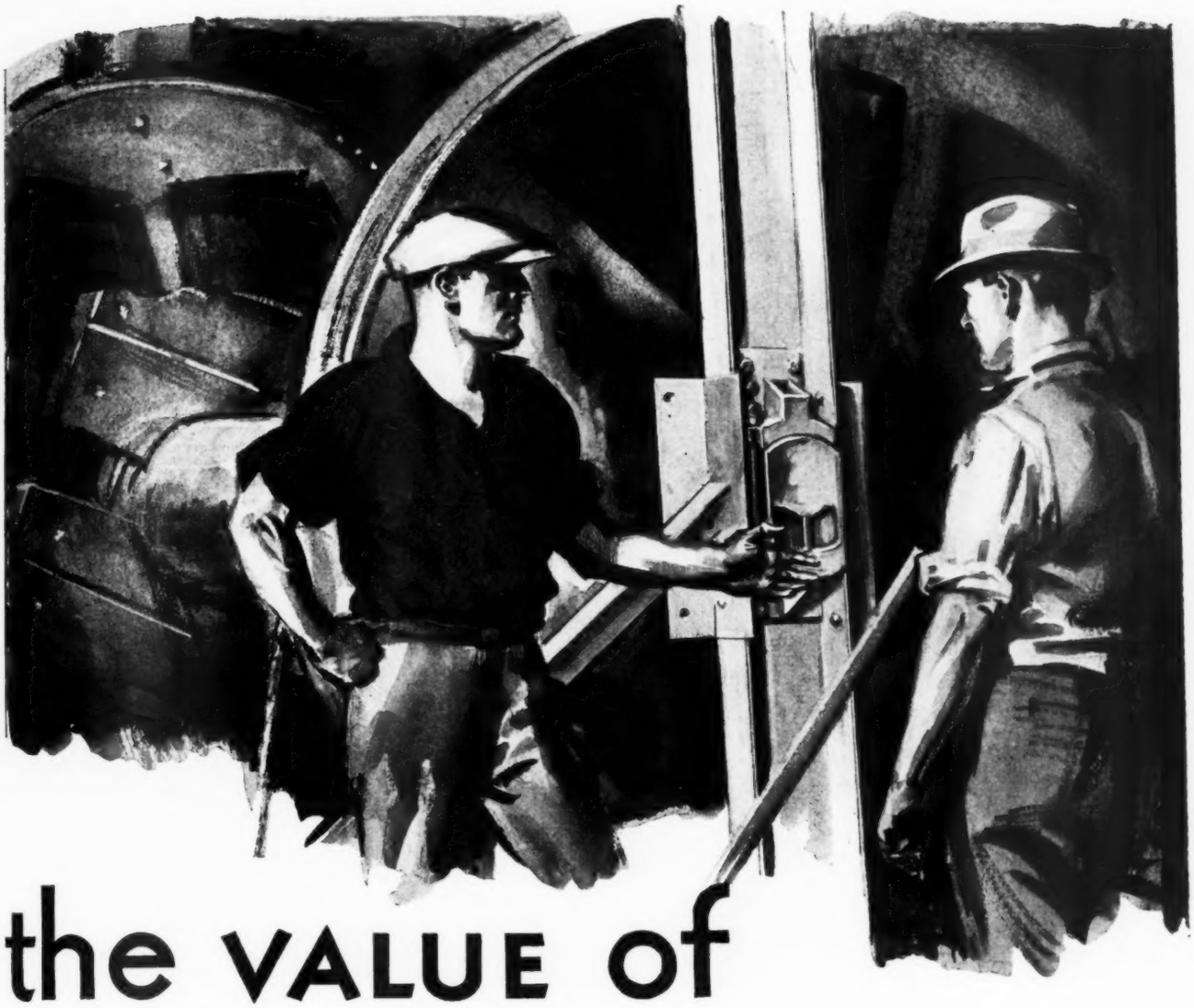

the VALUE of SELF-ALIGNING BEARINGS

a wheel from turning on its true axis. Ordinarily, the result is increased friction, unnecessary wear on the bearings, frequent rebabbitting and, of course, decreased operating efficiency.

In Moore bull and calf wheel posts, the bearing is free to adjust itself to the wheel gudgeon, permitting the wheel to turn freely. This automatic adjustment, together with the new effective means of lubrication provided, assures an even, free bearing surface at all times. The result is less friction, less rebabbitting and a bearing surface that lasts indefinitely. For extra heavy work, bearings can be furnished with cast white brass linings or bronze bushings.

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NEW MEXICO

Production, 1930—10,235,000 Barrels

Activity in New Mexico continues to decline, but operators still look upon it with much interest because of the big potential output of the Hobbs field and the state's big increase in production during 1930.

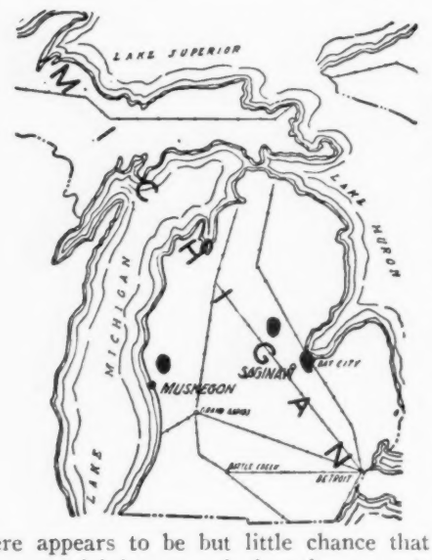
At the present time there are only 51 drilling wells in the state. During February there were 5 completions and 3 new rigs.

Of the activity in the state the Hobbs field had 3 completions, 3 new rigs and 15 drilling wells. This is quite a decline in operations for the pool.

Rotary tools are used by contractors in the Hobbs field, but cable tools are used in other parts of the state. The producing horizon at Hobbs is 4,200 feet and several upper gas sands are encountered.

MICHIGAN

Production, 1930—3,525,000 Barrels



There were 16 completions in Michigan oil fields last month. Operators were drilling 96 tests. A total of 41 new rigs were built during the month.

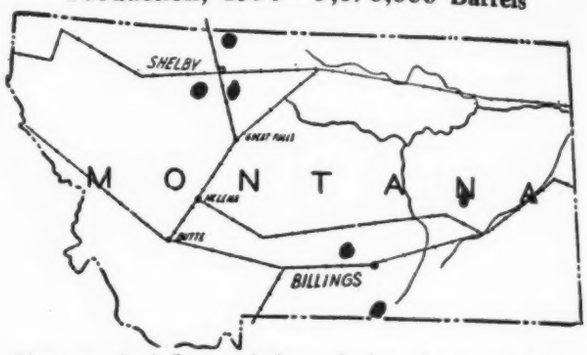
Practically all of the wells in the state are drilled with standard cable tools.

Operations in the state are declining and there appears to be but little chance that they will show any material increase during the present year.

● **Denotes oil and gas fields.**

MONTANA

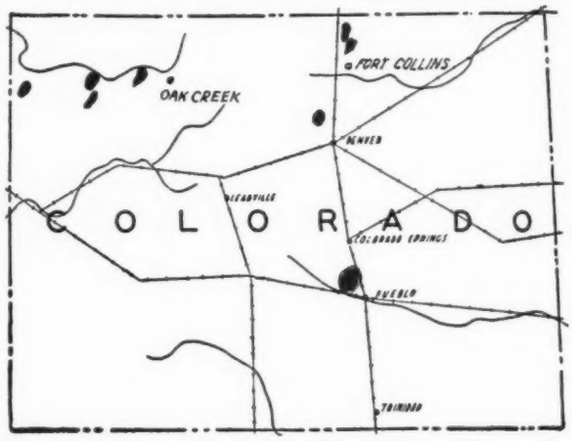
Production, 1930—3,070,000 Barrels



Montana had 5 completions during the month of February, during which time there were 20 new rigs built and a total of 75 drilling wells in the state. Utah, a neighboring state, had 1 completion, 1 rig and 20 operations. Cable tools predominate in use in both states.

COLORADO

Production, 1930—1,644,000 Barrels



Two completions, 13 rigs and 74 drilling wells constituted the activity in Colorado during the past 30 days. Both rotary and cable tools are used in the state, where formations are found at both shallow and deep levels.

INDIANA

Production, 1930—1,000,000 Barrels

There were 14 wells completed in Indiana during the past 30 days. The state had 46 drilling wells, but there was only 1 rig reported on the activity chart.

Cable tools are depended upon for all of the drilling operations in the state, where producing horizons are shallow and there are no heavy gas pressures.

THE FIFTH AD OF THE SERIES AND THE SECOND DEVOTED TO AXELSON PUMP LINES

...behind the scenes

IN RESPONSE to trade demand created by the increasing interest in durable and economical liners, Axelson has developed a liner of chrome nickel alloy steel manufactured by the most modern and efficient methods. Two factors are paramount in all Axelson machining processes, accuracy and workmanship. They dominate every manufacturing operation. Every operation, every test is designed to produce a liner with interior and exterior surfaces perfectly concentric, a liner with end surfaces absolutely perpendicular to the bore, a liner of long life that wears uniformly. They are apparent in the operation of specially built machines that mill both ends of the liner, in others that rough bore four liners at a time and still others that turn simultaneously the five outside liner ribs. They are responsible for the minute attention given to finish and facing, finish boring and final honing. No method of finishing the inside of a cylinder is as accurate as the automatic expansion hone, an exclusive Axelson feature.

Any Axelson representative will be glad to give you the full manufacturing story on Axelson Liners.

AXELSON MFG. CO., Ltd.
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New York City: - - 30 Church St.

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FRICK-REID SUPPLY CORPORATION

Straight line production...well-devised "follow through" of boring, reaming and finishing processes result in economical manufacture of Axelson Pump Liners.

A 2¼" valve ball may be placed in the top of a 2½" liner with a 2¼" I. D. and closed at the bottom by the hand. The ball is virtually supported by the air column thus formed for as long as a ten minute period.

Liners are subjected to chemical and microscopic analyses both in the rough casting form as well as in the finished state.

AXELSON PUMP LINERS

When writing AXELSON MANUFACTURING CO., LTD., *please mention The Petroleum Engineer*

Progress of Major Pipe Line Work

By J. H. DAMERON

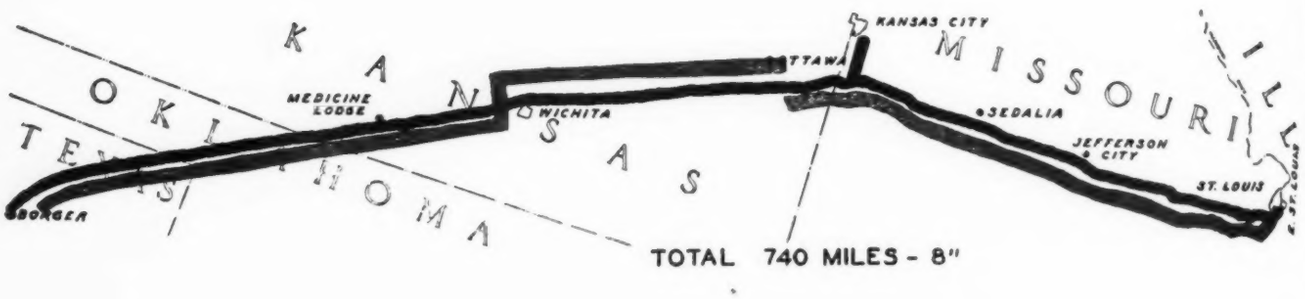
GREAT LAKES PIPE LINE CO.

WITH the continuation of mild weather the construction progress of the major pipe lines in the central United States has been rapid for the past 30 days. As a result several of the systems will probably be completed ahead of revised schedules and as this work draws to a close more than 1,000 miles of new main line work will probably be started in March and April.

Great Lakes Pipe Line Co., builders of a gasoline carrier from the Mid-Continent reaching into the Great Lakes area, is running gasoline from Barnsdall and Ponca City, Okla., to Kansas City, Mo. The Diesel engine reciprocating pump stations were used to test the line with water last month and following completion of the test the line was filled with refined products and deliveries started in Kansas City.

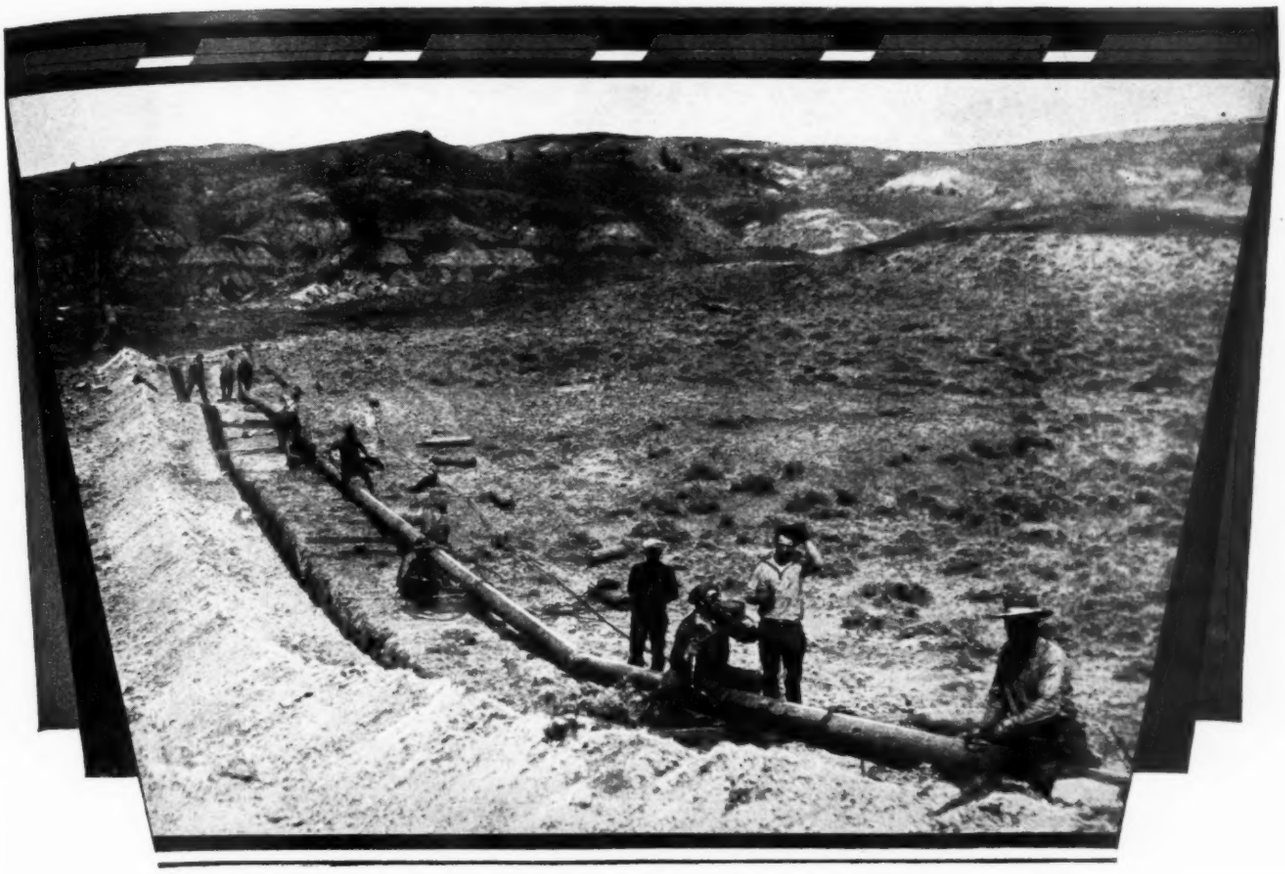
Line construction from Okmulgee and Muskogee north to Barnsdall, Okla., is being rapidly completed by Southwestern Construction Corp., contractors. Construction work on the 6-inch east of the Mississippi river has not been started nor has construction started on the 4-inch laterals running from El Dorado, Kans., to the main line or the lateral extending to Omaha, Nebr. Four stations north of Kansas City, Mo., have been started. Tankage at Barnsdall and Kansas City is complete and tankage at West Tulsa, Ponca City, Okla., Paola and Independence, Kans., and Des Moines and Alexander, Iowa, is being erected.

PHILLIPS PIPE LINE CO.



Phillips Pipe Line Co., builders of the 8-inch welded gasoline carrier from the Texas Panhandle to St. Louis, Mo., has completed all but a small gap near St. Louis, Mo. This construction work is being held up by right-of-way difficulties. It is expected the transporting company will commence building within the next 30 days its 53-mile 6-inch lateral running north to Kansas City terminal facilities. The gas engine centrifugal pump stations are pumping gasoline as far east as Wichita, Kans., and the remaining stations have been completed.

Indicates completed portion of line.
Indicates proposed route of line.



• • • • • • TO PRODUCE DEPENDABLE WELDS

IN welding gas and oil pipe lines selection of materials and instruction in correct welding technique are important factors of good welding practice . . . Under Linde Procedure Control careful and studied selection of materials and application of proven methods make oxwelded joints as strong as the pipe and permanently leakproof — 100 per cent efficient.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants UCC 627 Warehouse Stores

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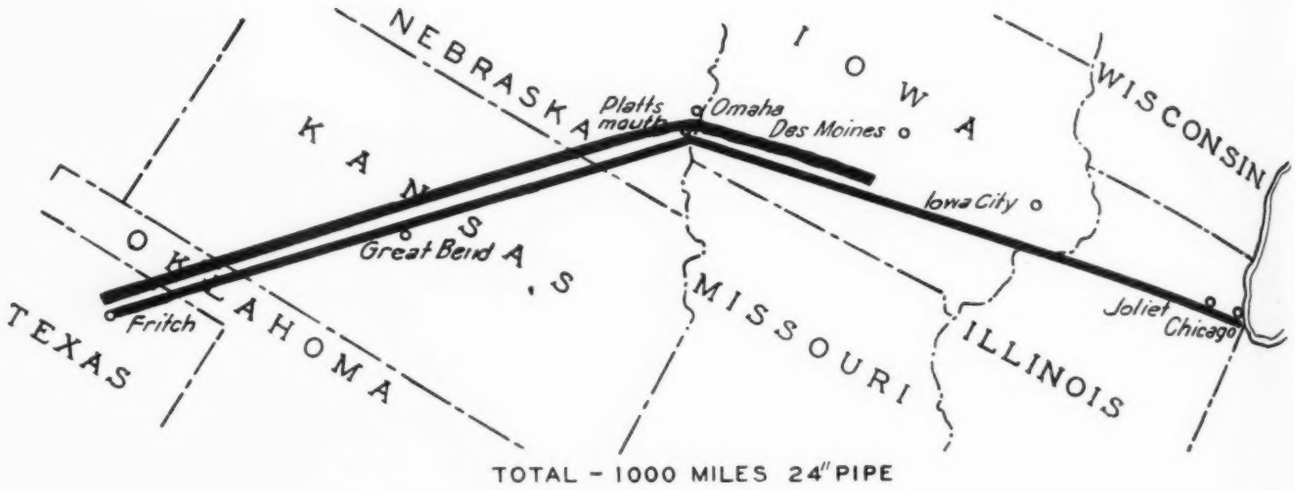
Buffalo	Los Angeles	St. Louis
Chicago	Memphis	Salt Lake City
Cincinnati	Milwaukee	San Francisco
Cleveland	Minneapolis	Seattle
Denver		Tulsa

LINDE OXYGEN · PREST-O-LITE ACETYLENE · OXWELD APPARATUS AND SUPPLIES · UNION CARBIDE

When writing THE LINDE AIR PRODUCTS COMPANY, *please mention The Petroleum Engineer*

CONTINENTAL CONSTRUCTION CORP.



Construction of the Continental Construction Corporation's 24-inch combination welded and coupled line from the Texas Panhandle to Chicago, Ill., has progressed to a point more than half way through Iowa. Oklahoma Contracting Co. is building the remaining 100 miles in Iowa and the Mississippi river crossing at Muscatine, Iowa, has been contracted to the Pacific Bridge Co., Portland, Ore.

Upon completion of its initial station in the Panhandle the transporting company will have the largest gas engine powered compressor station in the world. The station will have twelve 1,250-horsepower units. Stations 2, 3, 4, 5 and 6 are approximately 90 per cent complete and construction work has been started on stations 7 and 8.

PANHANDLE-EASTERN PIPE LINE CO.

The Panhandle Eastern Pipe Line Co., building a 20, 22 and 24-inch transmission line from the Texas Panhandle to Indianapolis, Ind., has its combination welded and coupled line complete to the Illinois line. Construction work on east, which has been held in abeyance by right-of-way difficulties, is expected to start some time in March. Most of the activities are concentrated on the construction of laterals in Missouri at the present time.

The line from the Mississippi river east will be built with 20-inch pipe and the contract has been awarded to Williams Brothers, Inc. Construction work at the compressor stations has been completed.

Indicates completed portion of line.
Indicates proposed route of line.

WINTER OR SUMMER PIPE LINES MUST BE LAID

AS TRUMAN-SMITH LAYS THEM—IN FIRST CLASS LEAK PROOF CONDITION

DRESSER COUPLED, SCREWED OR WELDED, THIS FIRM FINISHES THEIR LINES ON SCHEDULE

"The Truman-Smith Way is the most economical in the long run"

These pictures were taken on The Missouri Valley Pipe Line Company's section of 20-inch coupled pipe laid by Truman-Smith across Cerro Gordo County, Iowa. In spite of frozen ground and unforseen soil conditions causing unusual ditching difficulties, to date they are ahead of schedule.

The TRUMAN-SMITH CONST. Co.

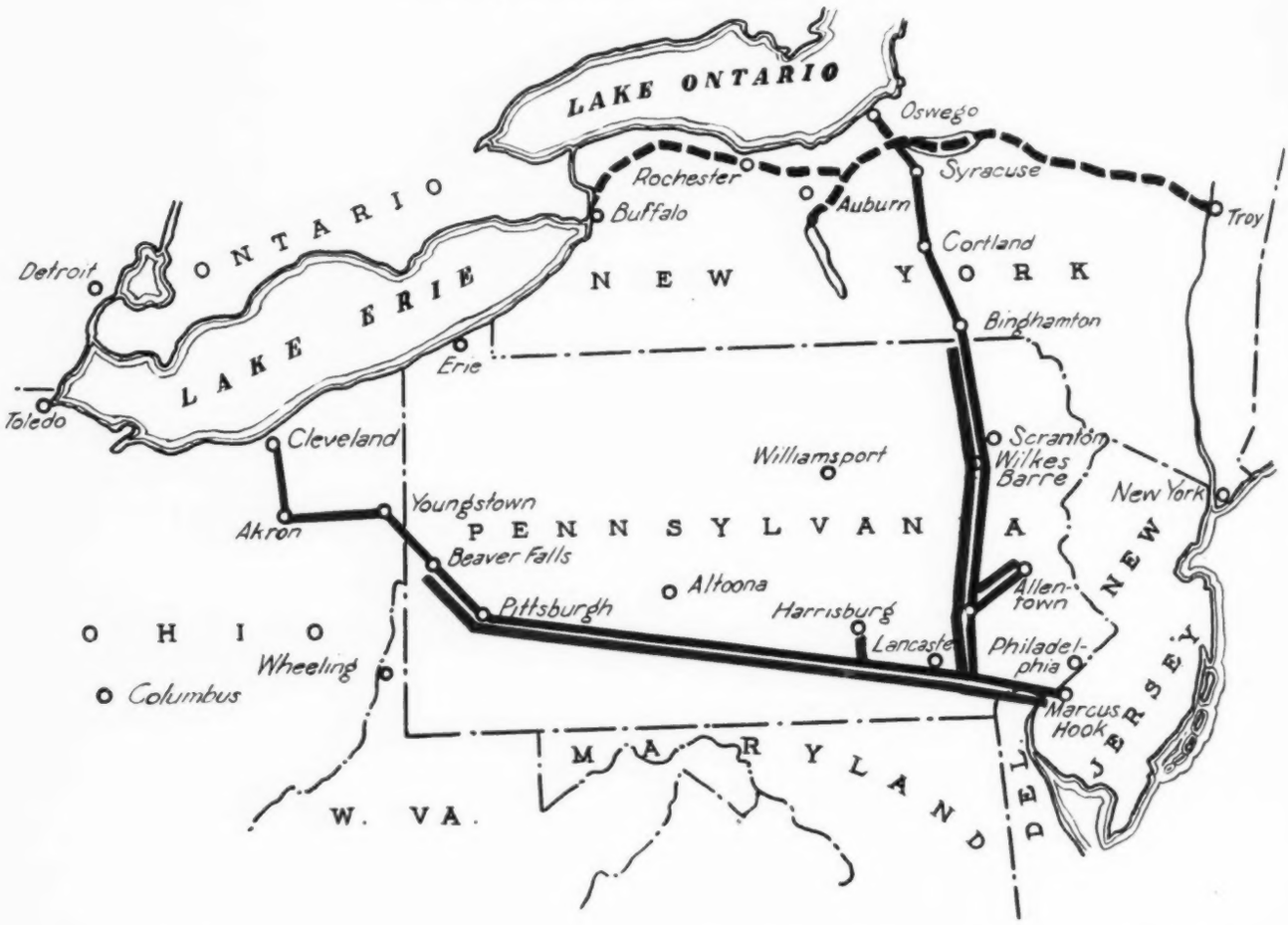
EL DORADO, KANSAS.

When writing TRUMAN-SMITH CONSTRUCTION CO., *please mention The Petroleum Engineer*

GULF PIPE LINE CO.

Gulf Pipe Line Co. of Pennsylvania, some time ago completed its main 10-inch welded trunk line from Oklahoma to Spencerville, Ohio, where the line intersects another oil line running east, and will start early in March on the laying of 49 miles of 8-inch from the main line to Cincinnati, Ohio. Upon completion of the lateral to the Ohio refinery the new Gulf system will have been completed.

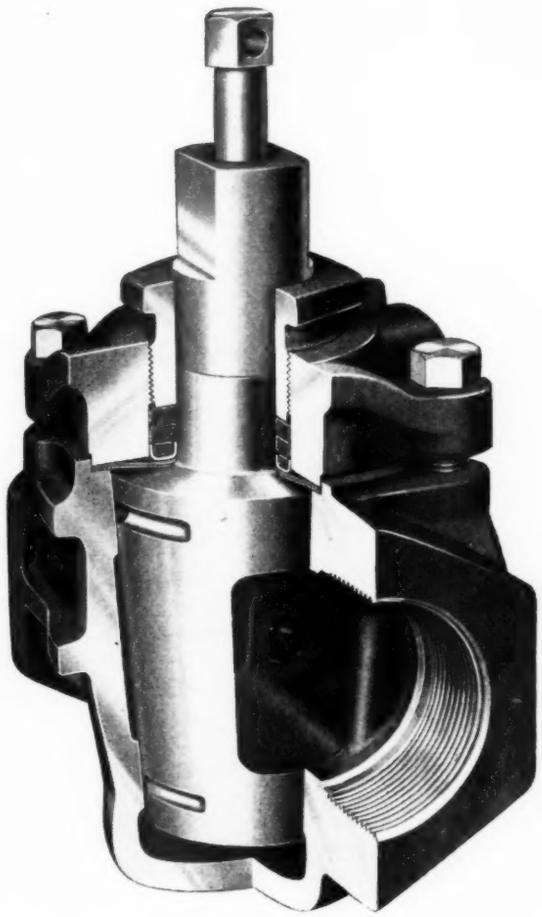
SUSQUEHANNA PIPE LINE CO.



Susquehanna Pipe Line Co., Sun Oil Co. subsidiary, will resume construction of its gasoline line with the opening of spring. Construction work was shut down during the winter months, however there is relatively a small amount of work ahead of the company and a part of the transporting system is now in service.

Indicates completed portion of line.
Indicates proposed route of line.

Why Nordstrom builds the PLUG COCK type of valve



Nordstrom Valve with patented "Sealdport" method of pressure lubrication. "Merco" lubricants should always be used.

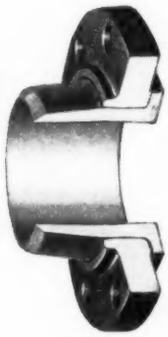
A plug cock by its nature provides the most effective form of valve for combating corrosion or erosion when the valve is used as a stop in a line. This is because when the valve is opened and the line content is flowing through the valve, none of the vital parts are exposed to disintegrating forces. No machined surfaces are being eroded or corroded. Even in the closed position, the portion of the plug surface which is in contact with the line content, is not the portion required to effect a shut-off with the interior ground surface of the body. The plug cock is also the simplest, most rugged type of valve.

Nordstrom has added to these advantages of the plug cock by embodying a method of pressure lubrication. By its use, plug cocks as large as 30" in size are perfectly practical and easily operated. Also, special "Merco" Lubricants introduced under pressure, offer the most effective method of sealing the valve against leakage long after an unlubricated valve might develop leaks.

This combination of the patented Nordstrom method of pressure lubrication and the natural advantages of the plug cock type of valve, offer the most satisfactory solution to valve problems.

ASK FOR LATEST CATALOG

MERCO



Also
"Merco" Flanges

A new type of flange joint for use with welded pipe lines requiring insertion of valves and fittings for the taking off of outlets. Extremely flexible. Size from 1½" to 10".

MERCO NORDSTROM VALVE COMPANY
SUBSIDIARY OF THE MERRILL COMPANY . . ENGINEERS

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Houston - Petroleum Bldg.
Los Angeles - 556 So. San Pedro St.
New Orleans - Masonic Bldg.
New York - 11 W. 42nd St.
Pittsburgh - Clark Bldg.
St. Louis - 317 N. Eleventh St.
San Francisco - 343 Sansome St.

Agencies:

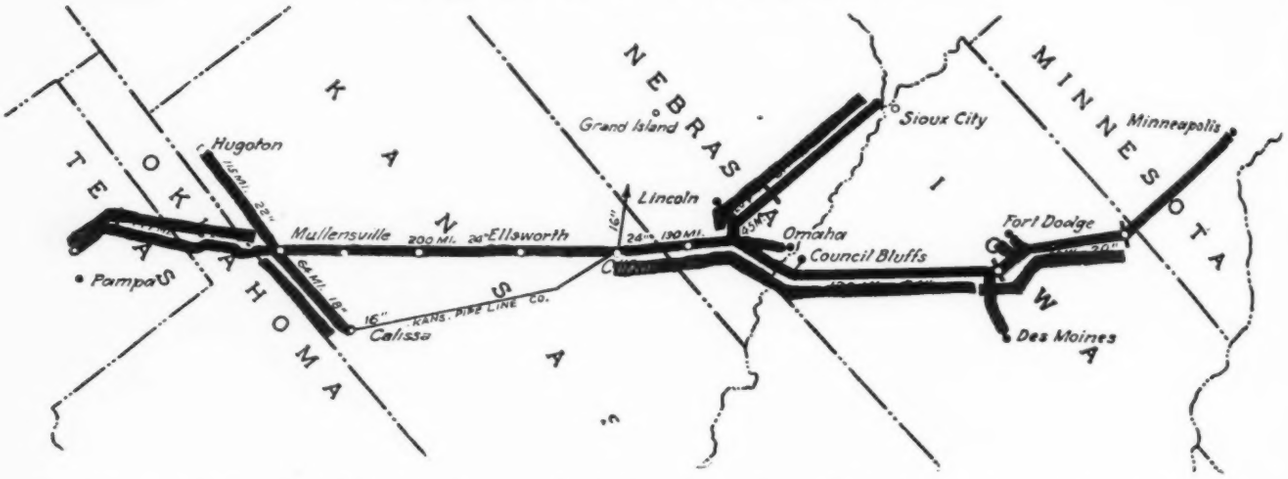
Denver - Republic Supply Company, 332 Continental Oil Bldg.
Honolulu - W. A. Ramsay Co., Ltd., Fort & Queen Streets
Philadelphia - Brown, Wilson & Company, 1600 Arch St.
Saginaw - Arthur C. Beckert, 112 Durand St.
Salt Lake City - National Equipment Co., 101 West 2nd South St.
Tulsa - B.V. Emery & Company, 216 E. Brady Street

Factories in U. S. Oakland, Calif. and Belleville, N. J.
Canada - Peacock Bros., Ltd., Montreal, Toronto, Winnipeg, Vancouver. (Also Sydney, N.S.)
England - Audley Engineering Co., Ltd., Newport, Shropshire.
Buenos Aires, Argentine, - General Electric, Soc. Anon., Victoria 618 Esq. Peru.

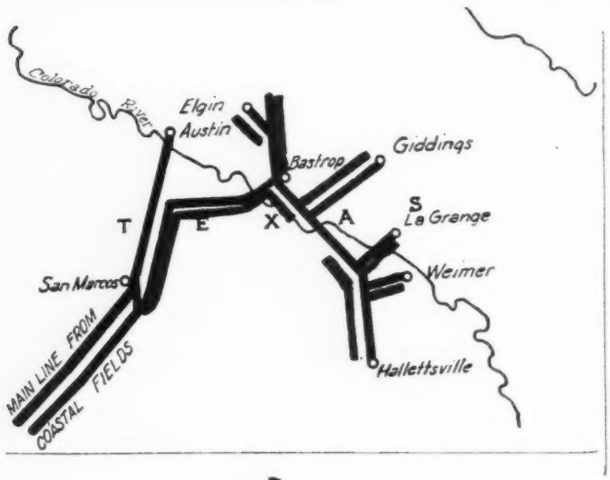
NORDSTROM VALVES

When writing MERCO NORDSTROM VALVE CO., *please mention The Petroleum Engineer*

MISSOURI VALLEY PIPE LINE CO.



The Missouri Valley Pipe Line Co. has completed its 950-mile construction program started last year, with the completion of its 20-inch main to Mason City, Iowa. This line originates in the Texas Panhandle and thus far has Sioux City and Mason City, Iowa, as its northern terminus. The transporting company has several hundred miles of extension work projected but thus far construction work has not been authorized.

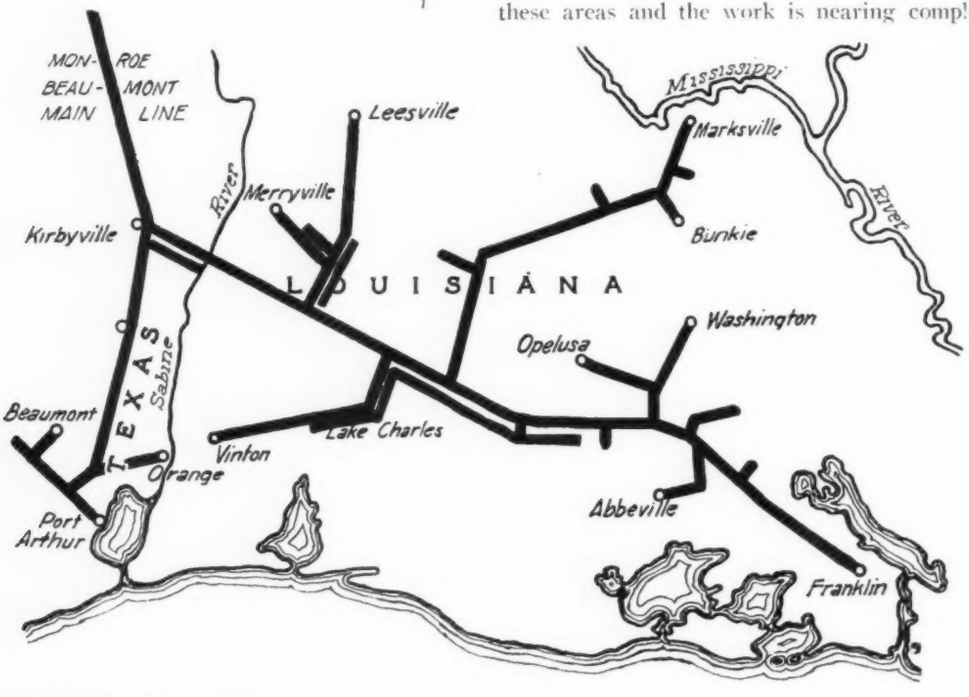


UNITED GAS CORP.

In the Gulf Coast area contractors building the United Gas Corp. gas system, blanketing southern Louisiana, are encountering rainy weather in laying the 158 miles of main line and 265 miles of laterals, most of which traverse low land. Consequently, progress has been retarded. This line traverses many rice fields and much of the country will be flooded when rice is planted.

Over in southwest Texas the same transporting company has completed approximately 80 per cent of its 110-mile extension work. This line also serves Smithville, Texas, and when the main system is completed it will not be placed in service until the city distribution systems have been completed in all of the towns served.

Additional compressor station capacity is being built to care for the increased loads placed on the main lines serving these areas and the work is nearing completion.



Indicates completed portion of line.
Indicates proposed route of line.

The Month's Activities *in* Refining*

By F. R. STALEY

REFINERIES in the eastern and central division ran more crude than during the previous month, while the figures for the western division showed a drop from 50.1 per cent to 48.0 per cent of capacity.

The Continental Oil Co. will build two new units in its Ponca City refinery. Alco Products, Inc., has been awarded the contract for a new 3,000-barrel pipe still and fractionating tower for rerunning pressed distillate. Soars and Lovelace, Inc., were awarded the contract for the construction of a six million cubic foot absorption and stabilization plant.

The new refinery of the Pure Oil Co. at Toledo is now under operation. The latest type Gyro vapor phase cracking units have been installed.

The Sunray Oil Co. of Tulsa will build a 5,000-barrel refinery and a gasoline extraction plant in Moore County, Texas.

The Leo Petroleum Co. of Fort Worth will build a 1,000-barrel topping plant.

The Northwest Stellarene Co. has overhauled its refinery at Shelby and enlarged its refinery at Coutts, Alberta.

The Standard Oil Co. of Ohio plans to build an asphalt plant at Toledo.

Many producers of distressed crude are building small topping or skimming units to produce gasoline, kerosene and fuel oil.

Several new refineries are under construction in East Texas. The Constantine Refining Co. is planning a 5,000-barrel refinery in Tyler. The East Texas Refining Co. has under construction a refinery at Henderson and one at Long View. The Beacon Refining Co. is constructing a plant in this field.

The Crown Central Petroleum Co. of Houston has contracted for a million barrels of East Texas.

The Stilson Products, Ltd., will erect a refinery at Wainwright, in Alberta. A catalytic process of cracking, invented by W. H. Stilson, will be used in the plant.

The Standard Oil Co. of Indiana has announced the addition to its line of Iso-Vis motor oils of an extra heavy grade. The base has an S. A. E. No. 70 viscosity.

Thirty-six oil companies have been asked to contribute to a fund of $100,000 to make possible for the year July 1, 1931, to June 30, 1932, continuance of the American Petroleum Institute's program of fundamental research in petroleum.

The A. S. T. M. will hold its Annual Group Committee meetings in Pittsburgh, March 16th to 20th. Much of the work transacted by the committees will be of great interest to petroleum refiners. The Annual Report of Committee D-2 on Petroleum Products and Lubricants will be formulated at this time.

Natural Gasoline

The Annual Plant Operators Meeting for the Ranger District, held under the auspices of the Natural Gasoline Association of America, will be held March 31st at Thurber, Texas, in the T. P. Club. Dean Hiatt is in charge of the program.

The Pure Oil Co. has installed a new treating plant for sweetening gasoline at Drumright.

Mariclare Utilities Co. has applied for a franchise to construct a gas plant and distribution system for butane gas for the town of Kennett, Mo.

The Union Oil Co. of California is building a new vaporization plant at Wilmington.

Champion Gasoline Co. has rebuilt its plant at Hynes, Calif.

*All statistics as of March 1st.

...An Enlarged

WITH the addition of an engineering department The Taubman Supply Corporation is admirably equipped to render a more complete service than ever to the producing, pipe line and refining branches of the industry. In step with the general acceptance of modern ideas, Taubman Service now extends from the furnishing of plans and estimates to the construction and complete installation of electric-centrifugal pipe line stations, whether automatically or manually operated. Taubman experienced engineers are available at all times for consultation.

For immediate delivery of any size shipment of Taubman-distributed products—tubing, line pipe, casing, drill pipe, valves and fittings — twelve efficiently-operated branches are maintained, one in each important field in the Mid-Continent. Carrying stocks commensurate with the needs in each field, these branches offer the **QUALITY, QUANTITY** and **SERVICE** long synonymous with the name Taubman.

Taubman Supply Corporation is factory representative for the following leading products:

Republic Electric Weld Pipe

More than three thousand miles of Republic Electric Weld Pipe are in use, giving uniform service regardless of whether conditions are favorable or adverse. High tensile strength, uniform wall thickness, efficiency of the weld, are factors contributing to the popularity of the product. Taubman Supply Corporation can furnish Republic Pipe in sizes 4″ to 16″ O. D., in lengths up to 50 feet, at the rate of 30 to 40 miles per day.

Pittsburgh Seamless Casing, Tubing and Drill Pipe

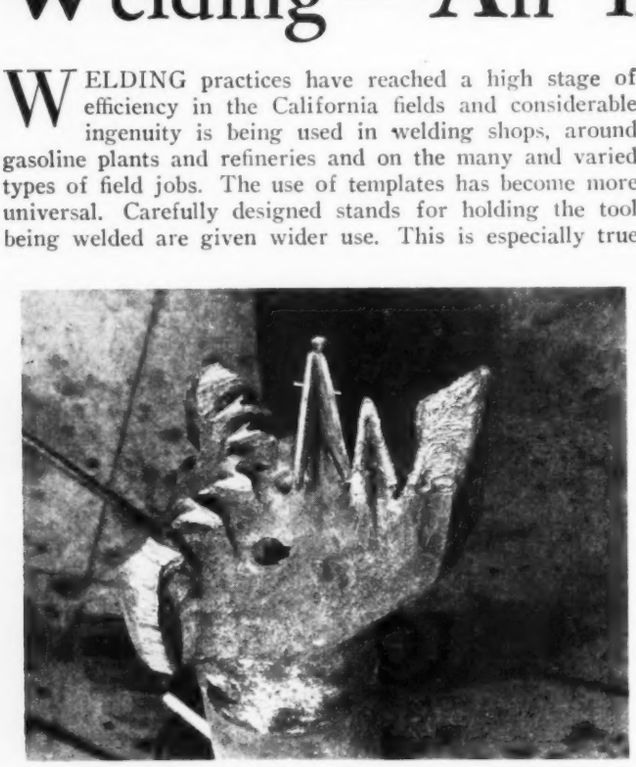
These products, for more than a quarter of a century, have been recognized for outstanding superiority and have made record after record for depth, setting time and long life. All material going into Pittsburgh Seamless products is carefully selected, rigidly inspected and must meet highest standards of excellence, accounting for the outstanding performance records made by Pittsburgh Seamless under most severe strains and at greatest depths.

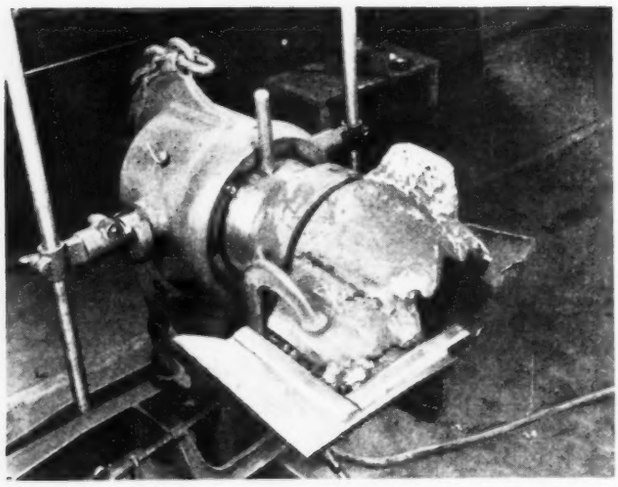
PIPE LINES UNDER CONSTRUCTION AND CONTEMPLATED FOR 1931

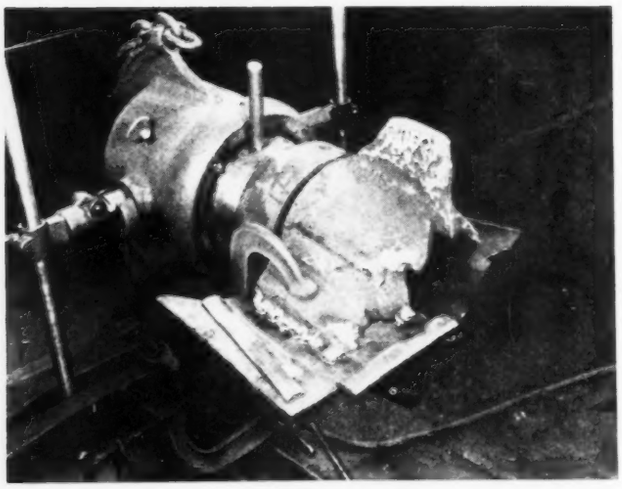
Type Line	Company Name	Headquarters	Initial Station	Terminal	Size Pipe	Length in Miles	Remarks
G. L.	Amtorg Trading Co.	New York, N. Y.	Moscow, Russia	Brown Coal Basin, Russia	....	150	Russian line, proposed.
G. L.	Associated Oil Co.	San Francisco, Calif.	Mid-State Fields	Tidewater	6"	60	To recondition 90-mile screw line and build 60 miles new line for gasoline carrier.
O. L.	Arkansas Fuel Oil Co.	Shreveport, La.	East Texas	Shreveport, La.	6"	.....	.....
G. L.	Arkansas Valley Gas Co.	Ft. Smith, Ark.	Ft. Smith		10"	80	Propose extension to cities south of Ft. Smith.
G. L.	Billings Gas Co.	Billings, Mont.	Dry Creek	Billings	....	120	Est. cost $2,500,000. Bozeman western terminal. Line to go to Helena and Butte later.
G. L.	Capital Gas Co.	Billings, Mont.	Eastern Montana	Winnipeg, Canada	....	400	Proposed.
G. L.	Central Montana Utilities Co.	Minneapolis, Minn.	Great Falls, Mont.	Lewiston, Mont.	8"	100	Proposed.
G. L.	Central Public Service Corp.	Chicago, Ill.	Kentucky	Muncie, Ind.	18"	260	Const. work by Central Nat. Gas Corp. Proposed.
G. L.	Colorado Nat. Gas Co.	Colorado Springs, Colo.	Stevens, Kans.	Colo. Sprgs.	12"	210	Proposed.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	W. Vir.	Wash., D. C.	20"	459	Completing survey and engineering const. expected to start in March.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	W. Vir.	Detroit	24 & 22"	300	Two river crossings in; no further work.
G. L.	Dominion G. & E. Corp.	New York, N. Y.	Turner Valley		....	.....	Proposed to build to cities in Alberta and Sask., Canada.
G. L.	Jerome Drumheller	Spokane, Wash.	Cut Bank, Wyo.	Seattle	20"	500	Proposed.
O. L.	Empire P. L. Co.	Bartlesville, Okla.	Oklahoma City Field	Houston, Tex.	10"	475	Proposed. Surveyed last year.
O. L.	Getty, Geo. F., Inc.	San Francisco, Calif.	Kettleman Hills	Tidewater	....	100	To be completed July 31, 1931.
G. L.	Great Lakes P. L. Co.	Ponca City, Okla.	Extend to Duluth		4"	150	Under consideration.
G. L.	Kentucky Natural Gas Corp.	Owensboro, Ky.	Evansville, Ind.	Terre Haute, Ind.	12"	110	Connor & Son, Contractors. Construction to start soon.
G. L.	Public Service Co. of Nebr.		Texas Panhandle	Colo. & Nebr.	18"	.....	Making property survey. Est. cost $7,500,000.
G. L.	Magnolia P. L. Co.	Dallas, Texas	East Providence, R. I.	Springfield, Mass.	6"	100	Buying material.
O. L.	Mexican Eagle Oil Co.	New York, N. Y.	Vera Cruz	Mexico City	10"	142	Under construction.
G. L.	Mississippi Industrial Gas Co.	Jackson, Miss.	Jackson Field	Terry, Miss., etc.	6"	140	Under construction.
G. L.	Minnesota Northern Power Co.	Minneapolis, Minn.	Williston, N. D.	Regina, Sask., Can.	12"	115	Proposed.
G. L.	Montana Power Co.	Butte, Mont.	Wyoming	Butte & Anaconda	....	.....	Est. cost $13,000,000.
G. L.	Memphis Nat. Gas Co.	Memphis, Tenn.	Extension of mains to W. Tenn.		12"	.....	Under consideration.
G. L.	Montana-Dakota Pw. Co.	Minneapolis, Minn.	Williston, N. D.	Minot, N. D.	12"	125	Making franchise surveys.
G. L.	Mo.-Kan. P. L. Co.	Chicago, Ill.	Jackson, Miss.	N. to present trunk line	....	.....	Rumored.
G. L.	North Central Gas Co.	Casper, Wyo.	Cut Bank, Wyo.	Bridgeport, Nebr.	14-12-10-8"	388	Reviewing bids.
G. L.	Okla. Nat. Gas Corp.	Tulsa, Okla.	Big Lake, Texas	San Angelo	12"	74	Under construction.
G. L.	Pacific Gas & Elec. Co.	San Francisco, Calif.	Sacramento, Calif.	Seattle, Wash.	....	500	Considering extensions to Oregon and Washington, also Kettleman Hills to Fresno.
O. L.	Sinclair P. L. Co. of Tex.	Tulsa, Okla.	East Texas	Houston	12"	250	Rumored.
G. L.	So. Saskatchewan Gas, Ltd.	Montreal, Canada	Bowdoin, Mont.	Regina, Canada	....	175	Proposed. Nesbitt, Thomson & Co. project.
G. L.	Southern Counties Gas Co.		Goleta	Ventura	16"	33	Cost $620,000.
O. L.	Stanolind P. L. Co.	Tulsa, Okla.	Carrollton, Mo.	Wood River, Ill.	8"	240	Rumored.
G. L.	Southern Fuel Co.	Los Angeles, Calif.	Kettleman Hills	Los Angeles	26"	185	Making survey. Construction will start in April.
G. L.	Tri-Cities Utilities, Ltd.	Regina, Saskatchewan, Canada	Kinsella Area, Canada	Regina, Sask.	24"	357	Est. cost $25,000,000; C. O. Moore Co. project; Ford, Bacon & Davis, engineers.
G. L.	Tennessee Nat. Gas Corp.	Chattanooga, Tenn.	Sunbright, Ky.	Chattanooga	....	160	Est. cost $2,000,000; contract to Gas Power Corp., 75 Broad St., New York.
O. L.	Illinois P. L. Co.	Findlay, Ohio	Yates, Tex.	Glenn Pool, Okla.	10"	.....	Rumored.
G. L.	Western Natural Gas Co.	El Paso, Tex.	El Paso, Tex.	Douglas and Bisbee, Ariz.	12"	300	Starting construction.
G. L.	Western Service Corp.	Oklahoma City, Okla.			8 or 10"	110	Propose main line extension in Mo. & Kan.

Welding—An Important Operat

WELDING practices have reached a high stage of efficiency in the California fields and considerable ingenuity is being used in welding shops, around gasoline plants and refineries and on the many and varied types of field jobs. The use of templates has become more universal. Carefully designed stands for holding the tool being welded are given wider use. This is especially true with drilling bits, the building up and repair of which, by means of welding and the employment of hard-facing materials have developed maximum volume of work in drilling areas.







Both the arc and oxy-acetylene methods of welding are in general use and even the smaller welding shops scattered throughout the fields are equipped to do either. There are certain advantages in each type and the particular application will govern which should be used under the conditions imposed. Speed is frequently a factor while the necessity for economies often influences the selection of the method to be employed.

In the Venice field considerable surface casing, or "stovepipe," has been welded. This, it has been found, is a rather economical method and, due to the system evolved, has proved to be rapid. One welding company has done most of this work by the arc method and has a truck available on which are mounted four generators. The bell and spigot type of joint is used and has been given the name of "slip-joint" by the welders. In general, however, one bead is welded around the joint proper before running it into the well and, wherever possible, the work is done on opposite sides simultaneously in order to equalize strains in the pipe. Either 14- or 18-inch strings are so welded, the size depending on the depth to which the well is to be drilled.

In the Signal Hill field, many strings of surface casing are being welded and in one case conditions made it desirable to weld a 2,800-foot string of eight-inch. The bell and spigot type is now used here, but at one time there were a number of strings butt welded. One of the greatest difficulties encountered in this procedure was caused by improper alignment and extreme care had to be taken in order to keep the successive lengths straight. A hinged collar was used to facilitate this. The ends of the pipe were butted against each other and this collar, made with an inside diameter equal to the outside diameter of the pipe, was then placed around the joint. Two slots were cut in the collar on opposite sides and the joint tacked through these. The collar was then removed and the weld completed.

Forms or templates facilitate repair and building-up work on many pieces of equipment. Rotary tables frequently are worn with the teeth practically intact on one side and mutilated on the other. Forms do much to speed up work on these besides insuring better jobs. Many other tools and parts of machinery used for drilling, production, in plants and in refineries are equally applicable to welding repairs and sometimes make the use of specially designed forms necessary. Electrolytic copper is well suited as a material for such templates since it will not adhere to welding deposits. The copper may thus be fitted to the piece being overlayed and the deposit poured directly against it to form any desired edge.

The many different kinds of special and patented bits now being used in the California fields well illustrate the advantage to be gained by proper application of forms.

Top—Here can be seen an electrolytic copper form for making a "finger" on a new type bit. Note the inserts placed ready to be taken up by the built-up portion. A completed projection is shown on the right. Center—A form used for welding up the edge of a core bit. The inserts can be seen in place ready for welding material to be deposited around them. Bottom—The welding work of the core bit finished around the inserts.

ing Phase *of the* Oil Industry

Hard-facing and diamond-hard inserts have become the vogue and the placing of these materials on the bit must be done correctly and with the least loss of time. Holders to keep the bit in correct position while the welding is being done and to hold the forms which assist in getting the desired edge are almost essential for fast and accurate work. Examples of these are well illustrated in the accompanying photographs. Hoods to protect the welders have also been developed to give better efficiency and complete protection to the operator.

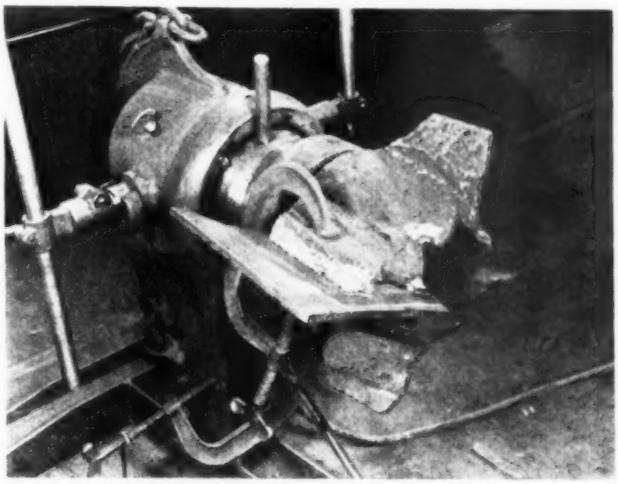
The kind of material used for welding in oil field work naturally varies widely because of the many different applications. The rods may be of mild steel, high carbon content or other alloy. Hard-facing may be the welding medium. All have their definite place and the character of the piece being welded, its ultimate use, the penetration desired, the probable distortion and the limiting heat are all factors in the selection and determination of the method best suited to the particular work to be done.

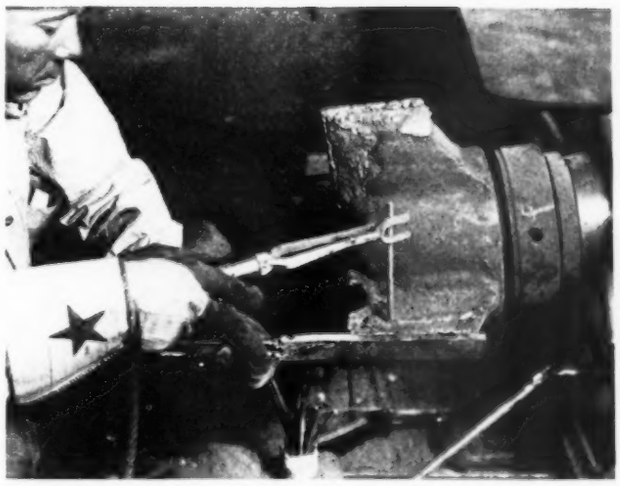
Deeper drilling and the precautions against crooked holes have both been influential in increasing welding operations and in developing the materials used. Present-day deep drilling demands a bit of different design from that entirely suitable for shallow wells. The gauge must be maintained throughout the run in order to eliminate future troubles and to keep the hole straight. Welding has been instrumental in providing a means of accomplishing this result by furnishing a medium for placing wear-resisting material in a manner and at a place on the bit where it will do the most good.

Welding has also made possible the constant servicing of the specially designed bits now widely used in California fields to meet increasingly difficult conditions imposed by deep drilling. Speed will always be an economic factor in drilling operations. Longer runs with fewer trips, holes kept in condition with fewer fishing jobs, a good sharp cutting edge throughout the run and other factors arising from a bit constructed with high wear-resisting material all have been aided by means of welding. The welding process in applying either hard-facing material or in setting diamond inserts is somewhat different from the ordinary welding jobs, since it involves a flowing on of material in nearly every case. There is no reason, however, why an experienced welder cannot soon become proficient in this class of work since the principles of good welding must necessarily apply.

Small pipe lines around the fields are being welded to a greater extent every year and many bends, both in a horizontal and vertical direction, are being made on the job with a torch for cutting the pieces to the desired size and angle and the ends welded to suit conditions. Some of the welding supply companies now furnish valuable handbooks on standard designs for this and other fabrication work.

The technique of welding can be obtained only through experience; and many gas welders had considerable difficulty in adapting their work to oil field requirements. With large welding companies it has generally been found advisable to keep welders on one method. This has not been followed by many of the small welding shops which, of necessity, must be maintained for small hurried jobs in an active drilling field. The variety of work being handled by these small shops gives a versatility to the welder and offers a valuable service in the handling of small jobs most conveniently and swiftly.





Top—Hard-facing material has been added. Center—The curved form is rigidly held up against the wing to be welded. Bottom—A straight edge form often is most convenient for bringing the wing out to gauge.

The BUTANE-AIR Gas Business

By **EMBY KAYE**, *Skelly Oil Co.*

IN a previous article the writer forecast an intensive development of a domestic and industrial gas business born as a result of the depression in which the natural gasoline industry then found itself. The butane-air gas business has become a business indeed.

It is recent history how large amounts of butane became available. On one hand, an increasing number of plants in the great Seminole, Panhandle and California fields were built to process the large volumes of gas made available in those fields, and on the other, the large refiners seemed, as if by a conspiracy, to have increased the capacity and efficiency of their vapor recovery plants, with the result that excessive volatility was available in the form of butane. Owing to vapor pressure limitations on his finished product, the refiner had to do one of two things: either reduce the volume of his natural gasoline purchases, or reduce the butane and propane content of the natural gasoline which he purchased. The latter course was to be desired because the use of the most stable naturals resulted in the building of the most desirable fuels.

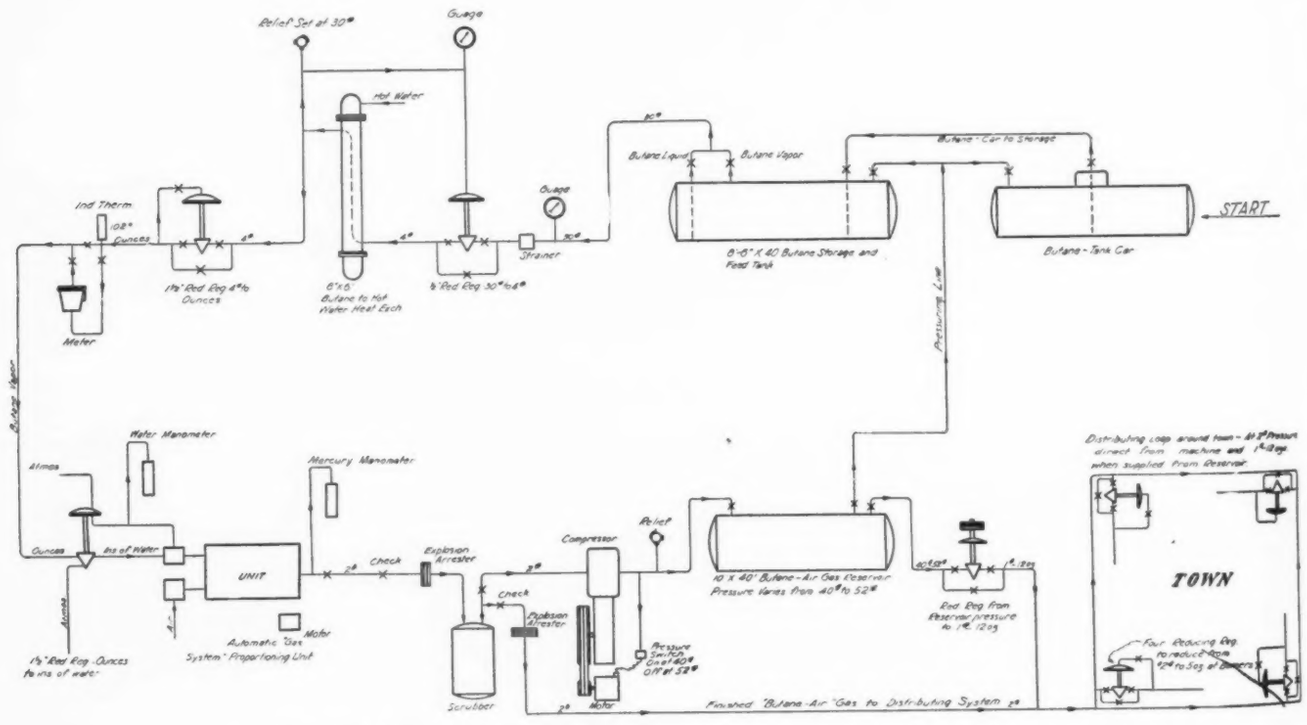
Butane is a by-product from the manufacture of refinery gasoline and natural gasoline. Due to the increasing requirements for controlled volatility of motor fuel, processes have been developed with which all excess butane is eliminated from such gasolines and distillates as are being prepared for motor fuel. This material has been developed and produced in relatively pure states and is now available in almost unlimited quantities from those manufacturers who have specialized in the development of the fuel.

Be it said to the credit of the Natural Gasoline Association of America that it sensed this situation over two years ago and through its specification committee set about to develop a set of specifications which would enable the refiner more closely to indicate just what character of natural gasoline he desired. The results of this committee's work are well known. That it was universally received attests to the need which existed for some such yardstick as has been provided by these new specifications.

It is in the debutanization of natural gasoline that butane is produced as the rejected product. It is, of course, available at some refineries as well as at many natural gasoline plants. Rejected, though it is in the final operation, butane is nevertheless absorbed and condensed, and is a highly refined and pure hydrocarbon gas when it is separated from the rest of the material which finds its way into motor fuel. As the natural gasoline market tends to make the more stable grades more easily salable, increasing volumes of butane will be available.

About a year ago most of the applications of this fuel were for industrial use. The problem of selling was confined to industries which already employed gas of one kind or another. Fuel engineers of the industries studied soots and butane supply, and on the basis of economies or advantages involved, installed a plant as a substitute for artificial gas. Few inquiries came unsolicited.

In the domestic gas field it was another story. The franchise field offered an opportunity for the promotion of plants. Countless inquiries came in from people sincerely interested but ill equipped with knowledge of the gas busi-



Type No. I butane-air fuel gas plant flow diagram taken from the layout in an eastern town.

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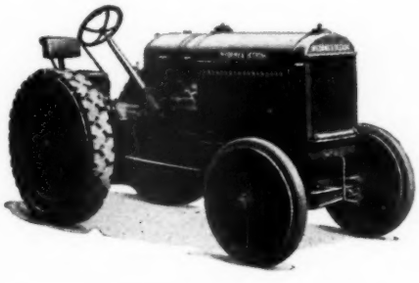

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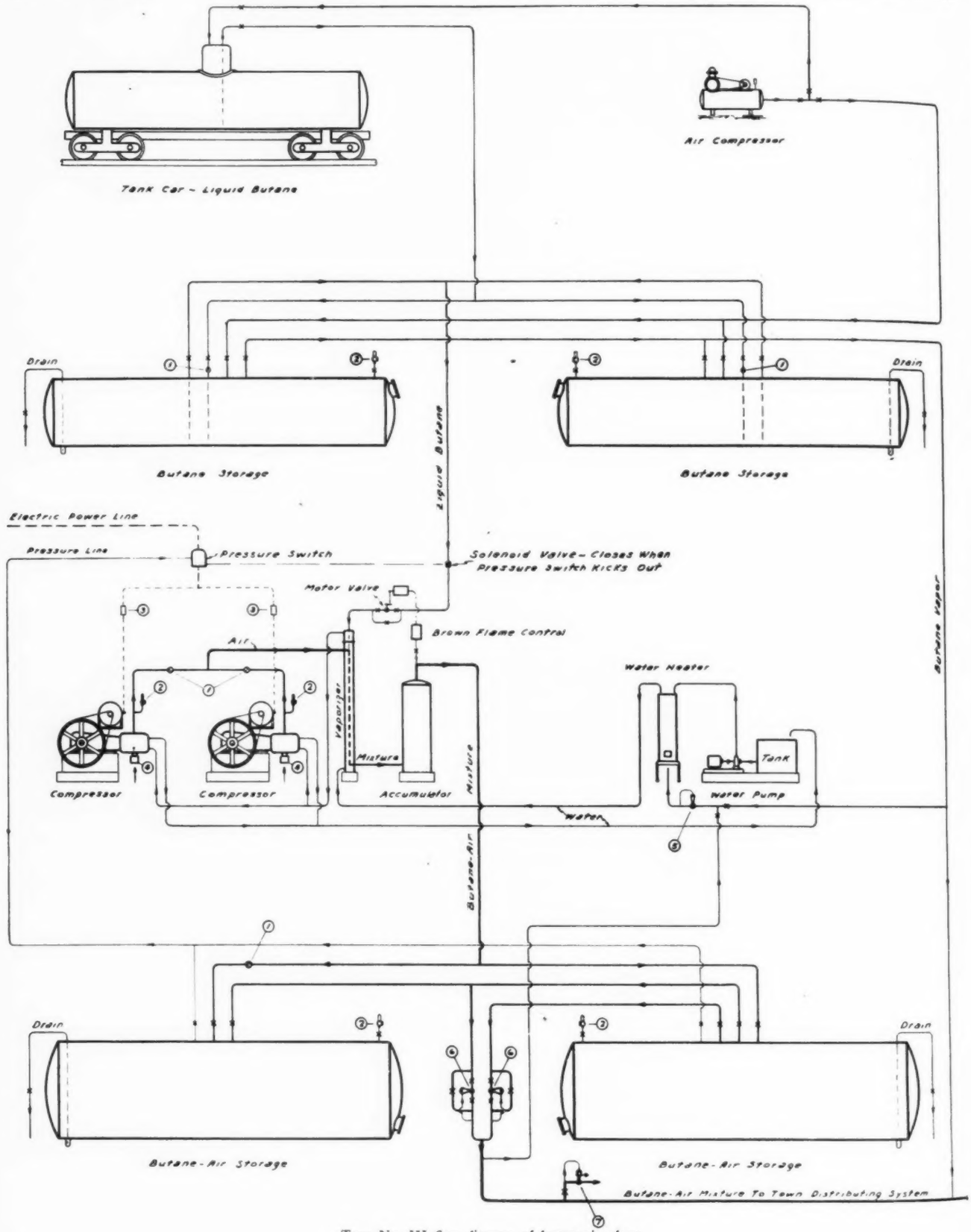
ness financing or franchises. While many informed and capable interests began to exploit this business, the selling of butane required, nevertheless, the development of a literature and an advisory engineering service. The several companies specializing in butane have advised prospective gas plant operators in matters of finance, of procedure in obtaining the franchise, and in the very art of manufacturing the finished gas.

Scores of these plants are now in use. One company alone has some sixteen plants in operation. Gas is being manufactured, sold and used, and some of the plants are already showing comfortable earnings. Other plants have a rather dark future ahead of them, for one reason or another. In one case the town could not support a gas plant, while in another the design of the plant makes for high operating cost and poor efficiency. There is no reason



Type No. III flow diagram of butane-air plant.

why, however, given a town of between 2,500 and 8,000 population, a fair and equitable franchise, a reasonable butane contract, a well designed plant should not be able to earn a handsome return on the investment.

The trend of development in butane-air plants has been along three lines more or less related, but each having its own advocates. The similarities and differences in functions are hereunder compared:

I and III are most radically different. A second, not shown, embraces features of the other two. Since I represents the type of plant which has been adequately described in trade papers, only differences in type III are pointed out, although a flow sheet and diagrammatic sketch of both are shown.

Whereas, in I the butane is vaporized and reduced to the air temperature, and proportionately mixed and then compressed to a predetermined delivery pressure, in III (the liquid carburetion process) only the air is compressed, the liquid warmed by passage through the compressed air stream and wholly or partially evaporated by the heat of compression. No reliance is placed upon the proportion of air and gas. The B. T. U. of the finished gas is the medium of control. Electrically operated apparatus actuates a needle valve on the liquid butane stream and only such volume of butane or mixed gases is permitted to enter the line as will hold the B. T. U. of the finished gas to within five B. T. U. of that desired.

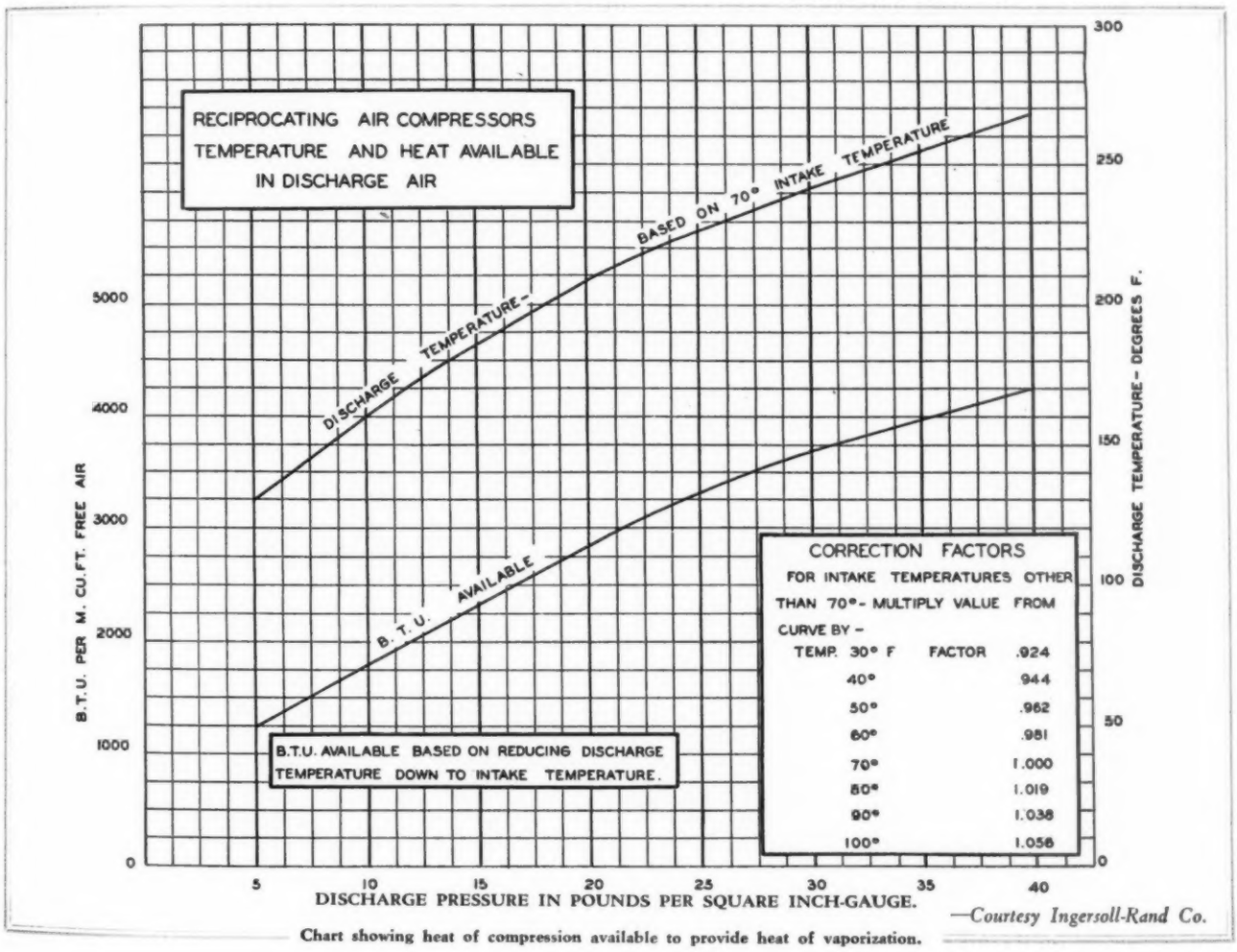
Not only does this type of plant make for economies of operation by eliminating the compression of butane and by using the heat of compression to provide a part of the latent heat of vaporization of the butane, but it does not depend upon any particular grade of liquefied gas.

In I it is most essential that the constituent composition of the butane be very definitely known. A given volume of vapors at a given temperature must contain a given number of B. T. U. or the finished gas will contain more or less B. T. U. In type III a touch of fuel may contain five per cent propane, 20 per cent iso-butane and 75 per cent butane, yet the finished gas will be uniform. The detector on the finished gas need only relay the drive to the needle valve on the butane line, and a correction has been made for the character of the basic gas.

The increasing reception by the "gas people" of type III increases the potential fuel supply. It removes the bugbear of very close separation of butane from other hydrocarbons. A carload of butane and propane without predetermined percentages is a good deal easier and less expensive to produce than any one of the hydrocarbons which are part of the mixed gas.

With the development of simple processes for air butane plants as described, only an improved financial situation generally is needed to step up the pace already set by this new business.

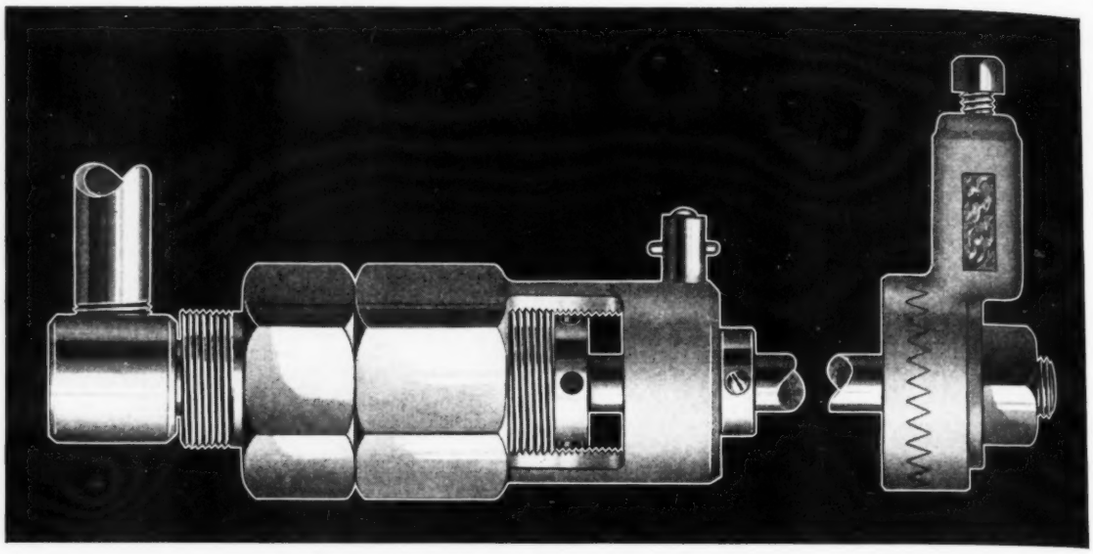
		I	II	III
1.	Vaporization	Direct Heat	Direct Heat	Direct Heat and Heat of Compression
2.	Mixing	Kemp Machine	Scrubber Tank	Scrubber Tank
3.	B. t. u. Control	Kemp Proportionator	Automatic	Electric Automatic
4.	Carburetion	Vapor	Vapor	Liquid
5.	Operation	Continuous	Intermittent	Intermittent
6.	Operating Pressure	2 Pounds	3-5 Pounds	3-15 Pounds
7.	Units	Double	Multi	Double
8.	Material Compressed	Air and Gas	Air	Air



—*Courtesy Ingersoll-Rand Co.*

Chart showing heat of compression available to provide heat of vaporization.

FISHER makes another Liquid Level Controllers



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new external ball-bearing stuffing box at no extra cost

This is further evidence of the policy to which Fisher has long been committed: Always to build a better product, and to pass on to the customer the benefits of its research and development work by giving the greatest value per dollar of cost.

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1. Radial and thrust exterior ball bearings make operation more accurate by eliminating friction and sluggish action. **2.** Greater dependability—sticking is prevented. **3.** Ball bearings cannot corrode because they do not come in contact with float liquid. **4.** Stuffing box is more accessible and requires less attention. **5.** All vital parts are forged stainless steel. **6.** Standard greasing connection provides for complete lubrication of bearings. **7.** Standard packing is used. **8.** Interchangeability on most Fisher rotary stem specialties.

All Fisher Liquid Level Controllers continue to have Stainless Steel Floats at no added cost

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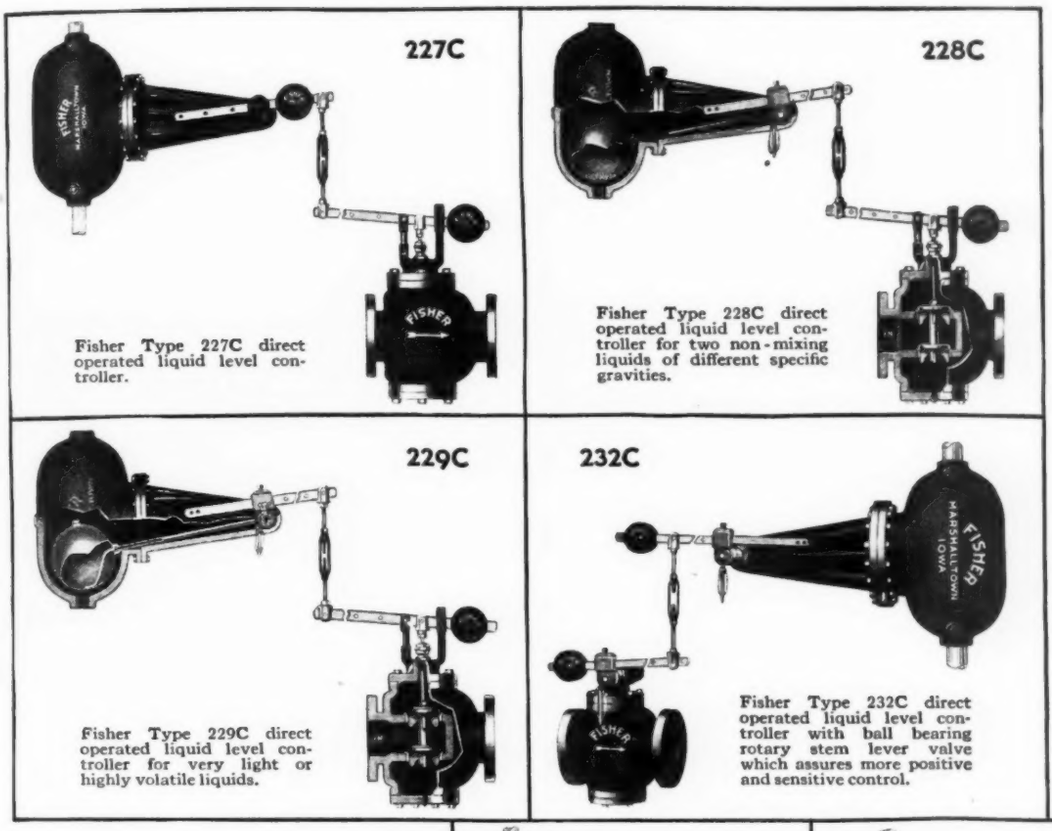

227C

Fisher Type 227C direct operated liquid level controller.

228C

Fisher Type 228C direct operated liquid level controller for two non-mixing liquids of different specific gravities.

229C

Fisher Type 229C direct operated liquid level controller for very light or highly volatile liquids.

232C

Fisher Type 232C direct operated liquid level controller with ball bearing rotary stem lever valve which assures more positive and sensitive control.

Fisher Liquid Level Controllers have long enjoyed a reputation for accurate and dependable control. That there is a Fisher Liquid Level Controller for every kind of service will be evident from the accompanying illustrations of the various types.

There are many thousands of successful installations on separators, stills, heaters, absorber towers, receivers, condensers, closed tanks, etc., etc.—proving Fisher Liquid Level Controllers dependable and accurate under all conditions.

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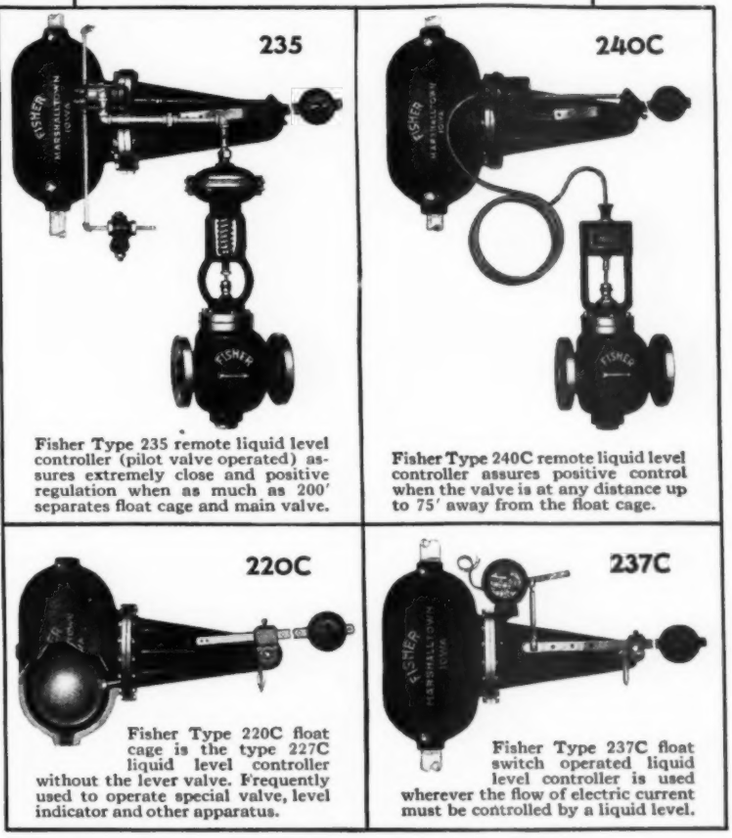

235

Fisher Type 235 remote liquid level controller (pilot valve operated) assures extremely close and positive regulation when as much as 200' separates float cage and main valve.

240C

Fisher Type 240C remote liquid level controller assures positive control when the valve is at any distance up to 75' away from the float cage.

220C

Fisher Type 220C float cage is the type 227C liquid level controller without the lever valve. Frequently used to operate special valve, level indicator and other apparatus.

237C

Fisher Type 237C float switch operated liquid level controller is used wherever the flow of electric current must be controlled by a liquid level.

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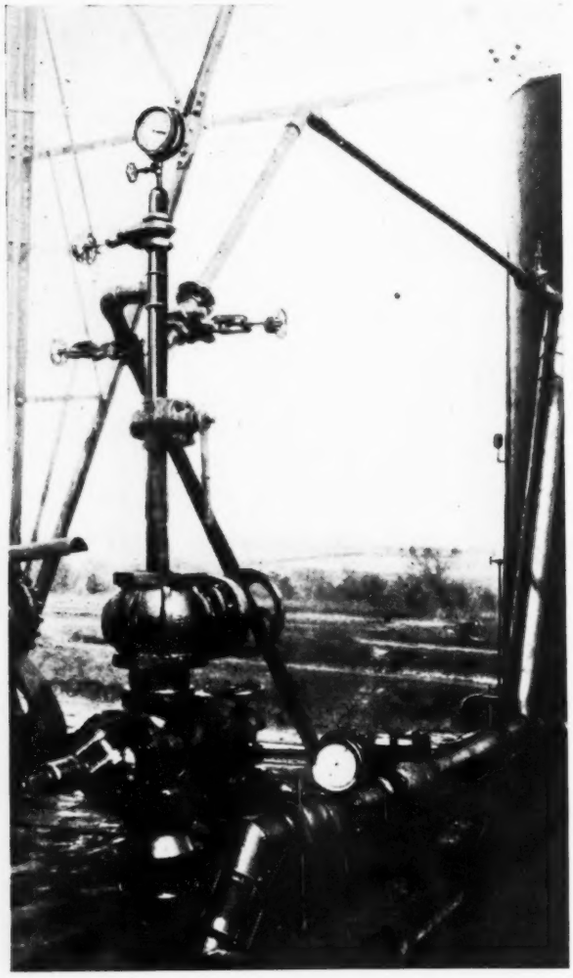


WELLS TUBED
While Producing
Under Control

KEEPING abreast of the latest field practice and taking full advantage of the modern equipment available, the Deep Rock Oil Corporation, Tulsa, recently completed running tubing in the flowing wells on its Rose Gibson lease in the West Asher-Wanette field in the Greater Seminole district, Oklahoma. Certain features of this successful piece of field work are of especial interest because of the well conditions under which the tubing was run and the methods and equipment used.

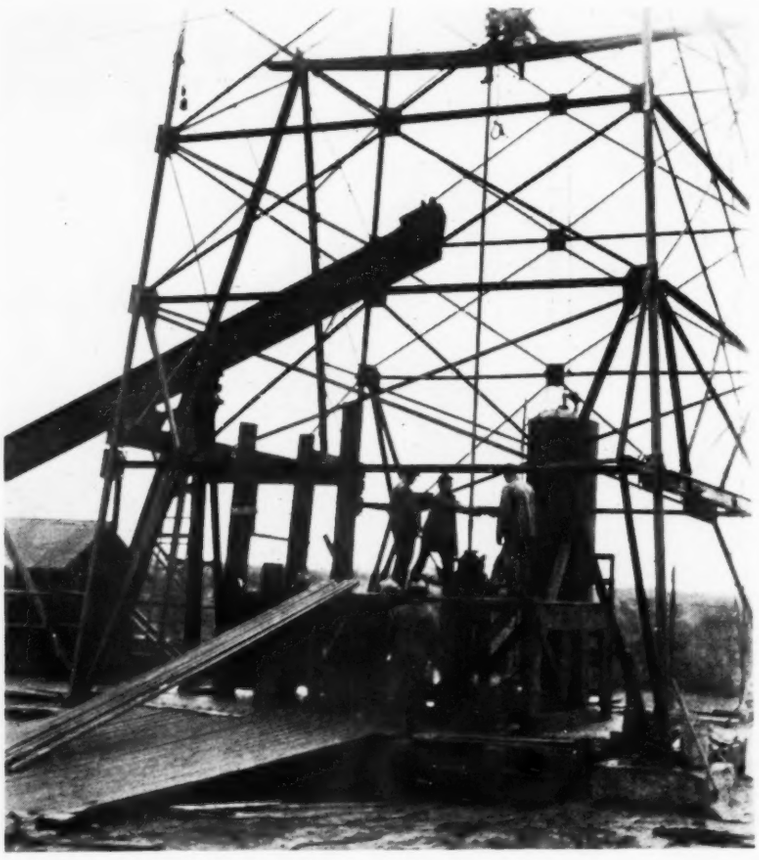
There are five wells on the lease and, although they are comparatively recent completions, tubing was installed at this early stage with the main purpose of obtaining better ultimate recovery by reducing the gas-oil ratio. Closer pressure control than was possible producing through the casing was also desired. By cutting down the gas-oil ratio the flowing life of the wells will be extended, thus lowering the lifting costs throughout the producing life of the property.

The wells are producing from an average depth of 3420-3450 feet and the daily initial production per well ranged from 585 to 2760 barrels oil and the gas-oil ratio from a few hundred to 4000 cubic feet per barrel. Bottom-hole pressures have never been taken in the wells, but the original rock pressure is estimated to have been 1100-1200 pounds per square inch. The estimated present rock pressure is 900-1000 pounds per square inch.

On all wells the inner casing string is 8¼-inch, which is set and cemented on top of the producing sand at about 3425 feet.

Of the five wells, three were tubed while flowing through the casing under pressure control. The two remaining wells, the smallest producers of the five, had accumulated a head of oil in the casing and did not flow while running the tubing; nevertheless, the same preparations were made and precautions observed as on the flowing wells tubed. Two-inch straight tubing was run in all five wells with a crew of seven men.

On this job the most important and essential items of equipment used were the tubing control heads, as they made possible the tubing of the well while flowing under controlled pressure. These were of the quick opening and closing type, 7-inch O. D. casing size, equipped with rams for 2-inch tubing. The lower control head was attached to the casing by a swage nipple. About eight feet above it the upper control head was placed. Between the upper and lower control heads a gate valve was connected. Both this gate valve and the lower control head were left on the well, the purpose of which will



Above—After the tubing is run the lower control head is left on the well together with the gate valve. This photograph illustrates a typical hook-up of a well on the Rose Gibson lease of the Deep Rock Oil Corp. in the Wanette-Asher field, Greater Seminole district, Oklahoma. Note that the 7-inch casing control head is connected by a swage nipple directly to the 8¼-inch casing of the well. Right—Running tubing in the Deep Rock Oil Corp.'s Rose Gibson No. 3 in the Wanette-Asher field while the well was producing under high pressure. This was done through two six-inch control heads equipped with two-inch tubing rams. A crew of seven men did the job.

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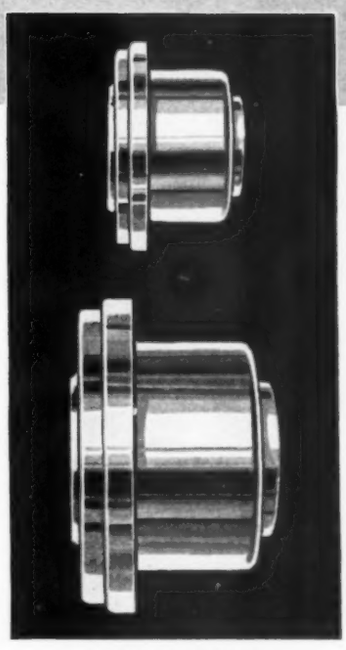

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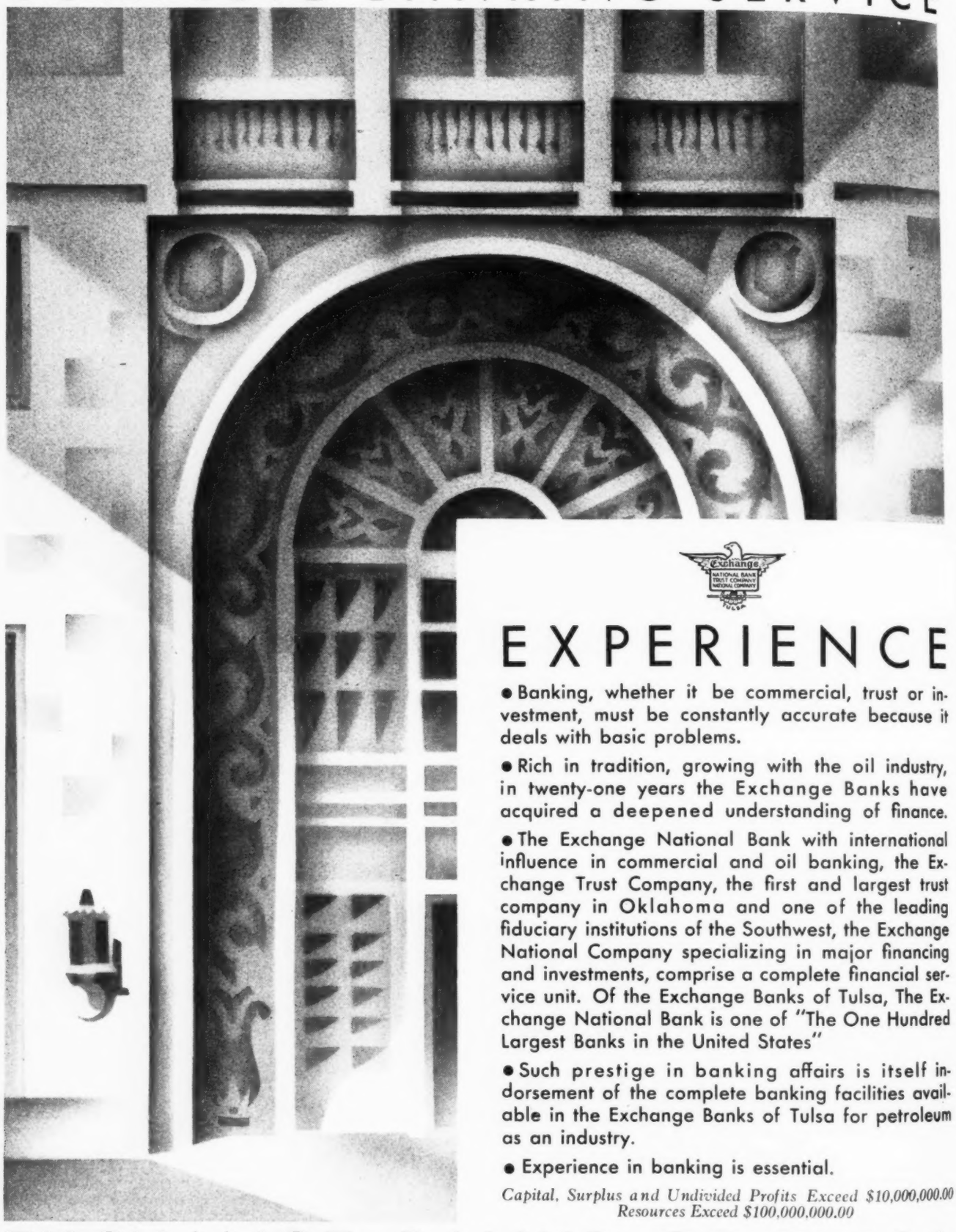

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- Rich in tradition, growing with the oil industry, in twenty-one years the Exchange Banks have acquired a deepened understanding of finance.
- The Exchange National Bank with international influence in commercial and oil banking, the Exchange Trust Company, the first and largest trust company in Oklahoma and one of the leading fiduciary institutions of the Southwest, the Exchange National Company specializing in major financing and investments, comprise a complete financial service unit. Of the Exchange Banks of Tulsa, The Exchange National Bank is one of "The One Hundred Largest Banks in the United States"
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be obvious by referring to the accompanying illustrations.

In running the tubing the upper and lower control heads are alternately opened and closed to let the tubing couplings pass. When screwing up a joint the rams of both control heads are tightly closed on the tubing. By this means all hazards and difficulties due to high pressure, or to gas or oil spray from the tubing or from between the tubing and casing when running in, are practically eliminated.

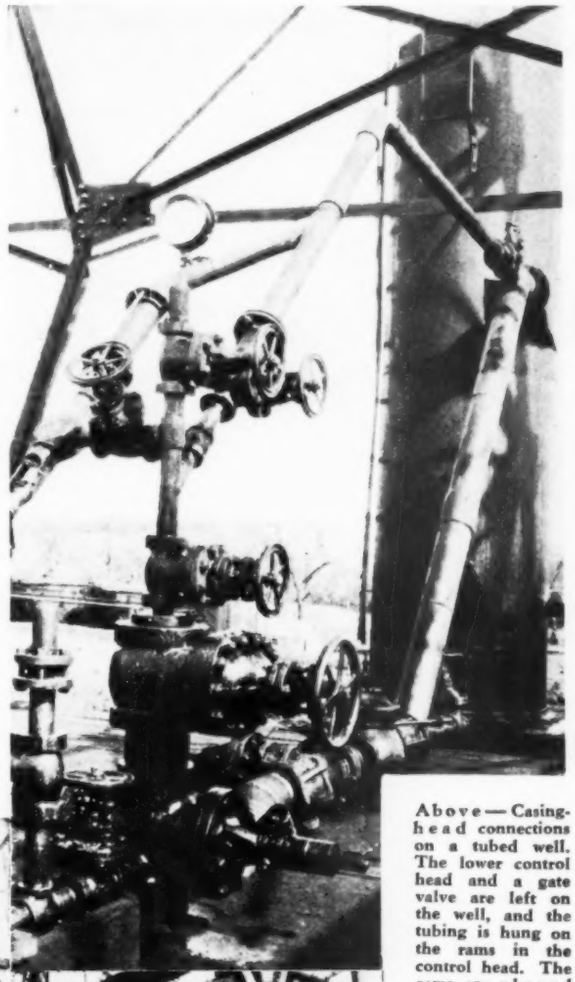
On the Rose Gibson No. 1, the first well and the smallest producer to be tubed, a perforated nipple was used on the lower end of the tubing, and, several hundred feet up, a flow device with a choke nipple. This well would not flow through the casing without some assistance, hence it presented no difficulties out of the ordinary run of tubing jobs.

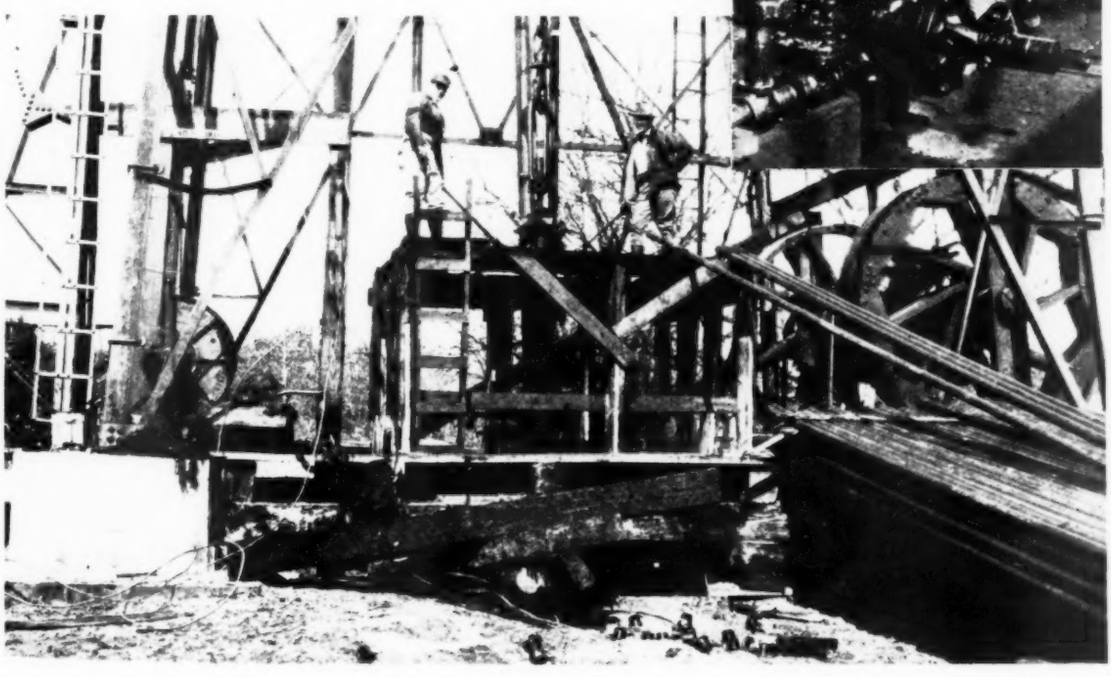
Rose Gibson No. 2, the second well to be tubed, was a flowing well. A breakable disc was inserted in the first joint above the perforations to prevent flow through the tubing while running in. No lubricator was used to start the tubing into the well and the first few joints were easily snubbed in by hand with the aid of a line and snatch block. This tubing string was run to within a few feet from the bottom and suspended on the rams of the lower control head.

Rose Gibson No. 3, the third well to be tubed, was also a flowing well and capable of a normal daily flow through the casing of 1700-1800 barrels oil with an estimated gas-oil ratio of 3500 cubic feet per barrel. When shut in, the casinghead pressure builds up to 750 pounds per square inch. During the running of the tubing the lowest casing pressure recorded was 100 pounds and the highest 580 pounds per square inch. On this well a specially-designed plug which is held in place by the well pressure was used to seal the tubing while running in. It was set in the first joint above the perforations. No lubricator was used to start the perforated nipple into the well. An interesting part of the work on this well was the starting of the flow through the tubing. When all the tubing was in, the upper control head and its connecting nipple were removed and the tubing flow line connected to the trap. To start the flow through the tubing it was necessary to release the plug on bottom by putting a pressure on the tubing sufficient to overcome the upward pressure on the lower side of the plug. This was done by filling the tubing to about 750 feet from bottom with oil (about 250 pounds per square inch pressure head), then turning gas at about 580 pounds pressure from the casinghead into the tubing. Within a few minutes the well started flowing through the tubing into the trap. The process was simple and effective in bringing the flow through the tubing under perfect control and with an absence of oil or gas waste.

On Rose Gibson No. 4, the last well to be tubed, the perforated joint was lubricated in through a 15-foot joint of 7-inch O. D. casing equipped with a tubing control head on its upper end.

On no well did the total time, including rigging up, running the tubing and connecting up to the trap, exceed two days. All work was done during daylight. In one well—the Rose Gibson No. 5—3300 feet of 2-inch tubing was run in the well in singles in four hours. This well was not flowing and partly accounts for the good time made. The best time made on a flowing well was on the Rose Gibson No. 3, when 2386 feet of tubing was run in 3½ hours.





Above — Casinghead connections on a tubed well. The lower control head and a gate valve are left on the well, and the tubing is hung on the rams in the control head. The rams are closed tight on the tubing and form a gas-tight seal between the tubing and the casing. By leaving the upper end of the tubing open thus, no connections have to be broken when the tubing is to be pulled other than removal of the bushing in the gate valve. Left — Well-head arrangements for running tubing in wells under pressure on the Rose Gibson lease of the Deep Rock Oil Corp. in the Wanette-Asher field, Greater Seminole district, Oklahoma.

Acid Treatment of » » »
Lubricating Stocks

By GEORGE PFAU *and* C. A. BARRERE, *Texas Pacific Coal and Oil Co.*

THE art of treating cylinder stocks and long residuums with sulphuric acid, is one that, in the past, has been handed down from one treater to another as one of the mysteries of the industry. The general technique and theory have been known, but nevertheless, the difficulties of obtaining satisfactory results on the batches have only been overcome either by the inherited knowledge and judgment of those individual treaters or by the hard school of experience of those who have chosen to work out their own methods. Formerly, when a bad treat was obtained, no data were available as to the causes and it was a matter of chance whether or not the trouble was immediately found and if the next batch would be satisfactory. It was difficult to find out the reasons why a good batch was good. Few of the factors governing successful treating were known by the old time treaters and as a result much important data were overlooked.

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Both chemical engineers of wide experience, the authors have prepared exclusively for The Petroleum Engineer a series of articles on refinery operations, of which this is the first.

The Texas Pacific Coal & Oil Co. refinery at Fort Worth, with which they are connected, uses such modern processes as contact filtration, vapor phase refining of cracked distillates and centrifuge dewaxing to produce completely dewaxed motor oils and bright stocks.

The acid treatment of the lighter fractions of petroleum was fairly simple, although the reactions were little understood. Problems such as the satisfactory mixing of the acid and the oil were easily mastered, similarly the problem of sludge separation worked itself out in a natural manner, due to the light, low viscosity oil; the question of temperature was unthought of because all treating could be done at atmospheric conditions. But, as the refiners began the manufacture of lubricating oils from various grades of crude, it was found necessary to apply sulphuric acid treatment to heavier fractions, from which were produced the several grades of lubricating oils, and as the fractions became heavier in viscosity, the treating problems increased. Later it was found that by acid treating the residues from certain types of crudes a satisfactory cylinder stock could be obtained. Finally the long residuum process was evolved whereby the various lubricating oils present in the crude were left in the still and this residue treated as one fraction.

The factors governing this particular type of acid treatment were found to be numerous and it was only by careful observations and the keeping of accurate records of the conditions of each treat, that definite data could be secured concerning the optimum condition so that methods of arriving at this condition could be obtained. For example, it was found that the conditions under which the oil was distilled had a very marked effect on the final color of the treat, and also upon the amount of acid used and the ease with which the acid "took hold." And these distillation conditions had to be changed so that the best results might be had and a uniform product obtained for the agitators. It can readily be seen that this is a very important condition if constant results are to be had and every refiner has had to solve this problem alone, for each had different equipment, a different raw material, and possibly a slightly different product to produce. All this took time and the gathering of data is a long and painstaking task. Progress has been slow, our methods have changed but little; but we are assembling facts on this subject which will undoubtedly lead to better methods and better products.

The hydro-carbon constituents in all petroleum crude oils are accompanied by asphaltic and resinous substances along with oxygen, sulphur and compounds containing nitrogen. There is also present in the various fractions, products of decomposition formed during the distillation process, all of which are detrimental to most of the finished products. The separation of such substances is the purpose of sulphuric acid treatment. The action of sulphuric acid of various concentrations on petroleum is one of the most complex in the subject of chemistry and, despite its almost universal use, it is only slightly understood.

In dealing with the acid treatment of stocks, there are several outstanding factors upon which the efficiency of the acid treatment is dependent. Any of these, improperly dealt with, will result in the failure of securing the optimum condition attainable. The factors are: (a) quantity of acid; (b) strength of acid; (c) fractional addition of acid; (d) temperature of treatment; (e) method of mixing; (f) duration of treatment; (g) coagulation of sludge; (h) removal of sludge; (i) separation of sludge.

Several graphs accompany this article illustrating the results obtained. The colors given are all Tag-Robison, taken at 150 degrees F. These colors were obtained by contacting the acid oil with 10 per cent clay at 420 degrees F. The acid oil was obtained from a long residuum of 92 Vis. at 210 degrees F.

Quantity of Acid

The quantity of acid used must be determined by trial. Acid is used to remove the asphaltic and resinous compounds, detrimental if left in the finished product. The amount of acid necessary will depend upon the concentration of these impurities in the oil treated and the extent to which it is desired to remove them.

As the quantity of acid used is increased, the removal of these undesirable compounds will improve and a more completely refined product will be obtained. This increase in refinement, as more acid is used, progresses slowly, in fact after a definite refinement is obtained, excessive quantities of additional acid will hardly improve the treated oil. There is generally a definite limit to the quantity of acid to be used, beyond which additional amounts of acid would not be economical.

The effect of increasing the quantity of acid used in treating is shown in Figure 1. By observing the curve it is seen that the color of the oil is improved as increasing quantities of acid are used. However, the amount of acid used increases at a much more rapid rate than the corresponding increase in color. This fact becomes more pronounced as lighter colors are obtained. After a 4 Tag-Robison color is obtained, an increase of 12 pounds of acid per barrel of oil improves this color by only ¼ Tag-Robison. Figure 2 illustrates the effect of increasing the quantity of acid used, upon the Conradson carbon residue. The carbon content of the oil is decreased as increasing quantities of acid are used, this decrease being at a much slower rate than the increase in the quantity of acid used. Figure 2 confirms the statement that more acid improves the degree of refinement. Figure 3 shows the effect of increasing the quantity of acid upon the sludge loss. On most Mid-Continent oils, the loss in acid-treating increases as more acid is used. This effect is not so noticeable on oils that contain very little asphaltic constituents which are easily attached or readily soluble in the sulphuric acid. The methods employed in distilling the crude will determine to a large extent the quantity of acid required for treating. If the oil is subjected to prolonged, excessive temperatures or insufficient steam agitation, in the distillation process, destructive distillation will result and larger quantities of acid will then be necessary to remove decomposed products. Overhead stocks will require from 30 to 60 per cent less acid per barrel than residual stocks, as most of the undesirable constituents are removed in the distillation process.

This is one of the most important factors in the refining of petroleum stocks for its action is, first, quantitative, for the proportion of acid necessary to obtain a certain color or effect rapidly increases as its strength diminishes and, second, below a certain limiting concentration the action of the acid ceases.

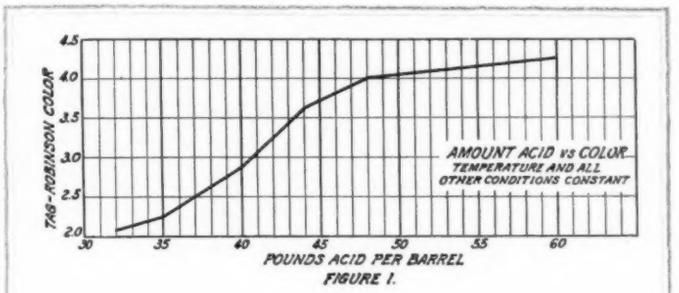

FIGURE 1.

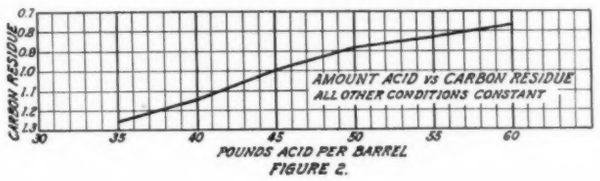

FIGURE 2.

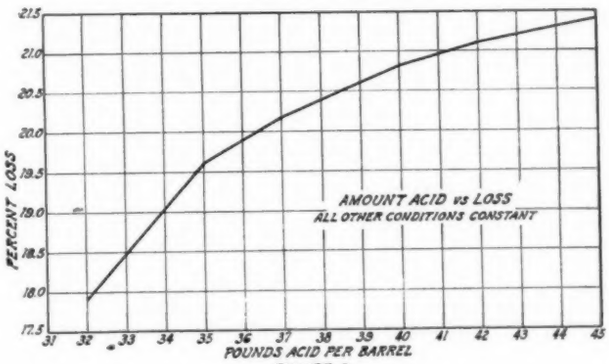

FIGURE 3.

Strength of Acid

Different stocks will react best with different strengths of acid. Generally acids of 93 per cent and 98 per cent sulphuric acid are employed. The strength of acid used determines the amount required for a given degree of refinement. Decreasing the strength of the acid used increases the quantity required. Concentrations below 90 per cent sulphuric acid are not feasible, except where recovered acid is used to dry the oil before the main treatment. In general, the use of 98 per cent acid will give a lighter colored acid oil than an acid of lower concentration. The loss in sludge is usually higher when 98 per cent acid is used; however, less clay will be necessary in contacting to obtain the desired color.

Fractional Addition of Acid

In almost all treating operations a much greater efficiency is obtained with a definite quantity of acid, when the acid is applied to the oil in more than one dump. The sludge should be allowed to settle and be drawn off after each individual treatment.

Usually there is a small percentage of water present in the oil to be treated. This tends to decrease the strength of the acid. Splitting the acid treatment into more than one dump eliminates this dilution of acid to a minimum. Where larger quantities of water are present in the oil, a water acid (½ to 2 pounds per barrel) may be used to dry the oil before the main dumps are added. The oil should be blown for three minutes with this small quantity of acid to absorb the water and the first dump of acid then added without attempting to gather any sludge that may form. In this manner the full effect of the acid is obtained as it will be added to the dry oil.

Many refiners find it economical to use recovered acid obtained from sludge of a previous treat, for the water acid and even for the first dump. The recovered acid should be from 50 degrees to 60 degrees A. P. I.

There is less temperature rise in the oil when the acid is applied in two or more dumps than when all of the acid

is added at once. High oil temperatures will result in loss of color.

Oils that contain a high percentage of asphalt may be treated in three separate dumps. Best results are obtained on most Mid-Continent oils by treating them in two dumps. These may be equally divided, or the first dump (cutter) may contain five to ten pounds less acid per barrel than the second dump. Generally, a stock obtained from a crude that contains one per cent or less of asphalt will treat best with a cutter acid (first dump) of 8 to 10 pounds less acid per barrel than the second acid. The total amount of acid

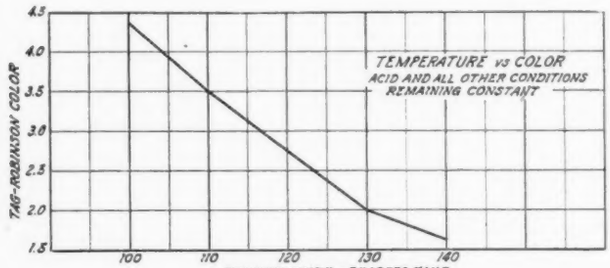

FIGURE 4

necessary will have to be determined by trial. This quantity will vary from 25 to 60 pounds of acid per barrel of oil treating, depending upon the nature of the stock and the color desired.

Temperature of Treatment

The influence of temperature on the refining process varies according to the effect which it is desired to obtain. If as complete a decolorization as possible is desired the lowest possible temperature should be used, the viscosity and pour point of the stock under treatment determining the minimum temperature possible. If too low a temperature is employed, the oil and acid will not receive intimate contact and difficulty will also be experienced in drawing off the sludge, causing excessive losses due to entrainment of the oil in the sludge. Also large quantities of pepper sludge will remain suspended in the oil and some sludge will float in a foamy mass on top of the oil. This unsettled sludge will continue to react with the oil, some of it re-dissolving and, as a result, the oil will be darkened. Once this condition occurs, blowing the mass again with air is the only remedy and this again is harmful.

If, on the other hand, the principal object is the separation of asphaltic substances alone, the opposite method must be followed. However, the color of the refined product is commonly accepted as the most important criterion of its quality, although the correctness of this may be doubted, as traces of coloring matter, which may darken the product, may not in any way be detrimental to the oil or its uses. Good color is impossible with high or excessive temperatures in treating, because coloring substances are formed by oxidation which are soluble in the oil. However, with the rise in temperature the action of the acid on the aromatic and unsaturated compounds is increased, so that if color is not of paramount importance, higher temperature may be used. For good colors, stocks of 80 to 100 viscosity at 210 may be treated at 105 degrees to 110 degrees F. Those of 150 to 190 degrees F. viscosity at 210 may be treated at 130 to 140 degrees F.

Figure 4 shows the effect of treating temperature upon color. The harmful effects of too high a temperature are pronounced. Figure 5 shows the effect of excessive heat upon the finished color obtained on the acid oil. Two batches of oil were treated under similar conditions, the difference being that one agitator was insulated, the other not. The insulated agitator held the heat generated by the acid reaction while the uninsulated agitator was able to liberate most of its heat to the atmosphere. A superior color was obtained in the uninsulated agitator.

Using the two-dump method of treating, the temperature may be controlled more accurately throughout the treatment. There is always a rise in temperature after the acid treatment, varying from seven to twenty degrees, dependent upon the amount of acid used. After the sludge from the first dump is drawn off, the acid-treated oil should be cooled to the initial treating temperature before the next dump of acid is added. A much better color will be obtained on the finished oil if this precaution is taken.

The temperature also has great influence on the rapidity with which the sludge settles out. As the viscosity of the oil decreases with a rise in temperature, the settling of the sludge naturally increases as the temperature rises.

Method of Mixing

Thorough mixing of the oil and acid is essential for the success of the operation and it is self evident that only by vigorous agitation can the acid be divided into minute particles and its active surface increased. Air agitation is almost universally employed because it is simple, complete in its action and relatively cheap. Mechanical agitation was originally used but difficulty was encountered in obtaining complete contact between the reacting products. Also it soon proved to be expensive for upkeep.

Air has in itself an oxidizing action on the stock and this action may be of considerable importance. Agitation with air for too long a time in the presence of acid may bring about, not only deterioration in the color of the product, but also cause the formation of acids which may not be removed by subsequent treatment. Too violent agitation will disintegrate the sludge formed into very fine particles which will give difficulty in the settling of the sludge. Dry air should always be used, otherwise it will dilute the acid and tend to increase the heat of reaction.

The acid should be sprayed upon the oil through a spider

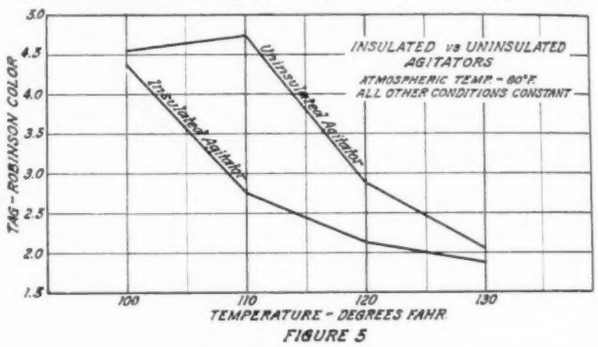

FIGURE 5

having openings of ⅛-inch at an angle of 45 degrees with the surface and about three feet above the level of the oil. This insures a more gradual and more complete distribution of the acid.

Duration of Treatment

The oil should be blown long enough to insure complete contact between the oil and acid. If the period of blowing is insufficient, there will be a loss of acid as more will be required to obtain the desired color. The sludge will also be oily when drawn off. Over-blowing will cause an accumulation of pepper sludge that will defy settling and will require an excess of clay for its removal. Continued blowing will cause re-solution of sludge particles which will darken the color. Prolonged agitation with air may also have the harmful effect of oxidation, especially at elevated temperatures. If blowing is carried too far, valuable lubricating constituents will be removed as sludge and the quality of the finished product lowered. When treating by the one-dump method, the time usually required for a 1,000-barrel acid treat is one hour. This largely depends upon the nature

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of the oil treated, the quantity of acid used and the treating temperature.

When treating oil by the two-dump method, the time of blowing the cutter and body (first and second respectively) will vary according to the same factors as with the one-dump treat. Usually the cutter acid is blown for a much shorter time than the body acid. This is probably due to the selective action of the sulphuric acid and one of the reasons a two-dump treatment is more efficient.

Ordinarily from 5 to 10 minutes' blowing will complete the cutter acid reaction. Further blowing will result in an inferior color on the finished treat, which can only be overcome by additional acid. Figure 6 shows the effect of the time blowing the first acid versus the finished color after the treat is completed. It may clearly be seen that a poor treat may be the result of over-blowing the first dump. On oils containing more potential sludge-forming compounds, the blowing time of the cutter may have to be increased to a half-hour. The body acid (second) requires from three to four times the treating time as does the cutter. The more easily removed impurities have been taken out and the reaction has to be prolonged. The average time required for a 1,000-barrel treat on the second acid is from one-half hour to an hour, depending upon the same factors outlined above. Figure 7 shows the effect of blowing the body acid upon the resulting color. If the oil is not blown long enough a loss in efficiency results. If the oil is blown too long, a poor color will be obtained. Experimental work is necessary on each oil to determine the proper time the oil should be blown.

When the reaction is completed the sludge should be removed as rapidly as possible. This sludge is usually divided into small particles which remain in suspension for a long time and delay the process and cause a deterioration in color owing to partial re-solution of the separated sludge. To accelerate the precipitation of the sludge, various methods have been tried; materials such as sand or fine clay have been recommended in order that the finely divided particles may be united to form larger bodies with the grains of these substances. Others have used small amounts of strong

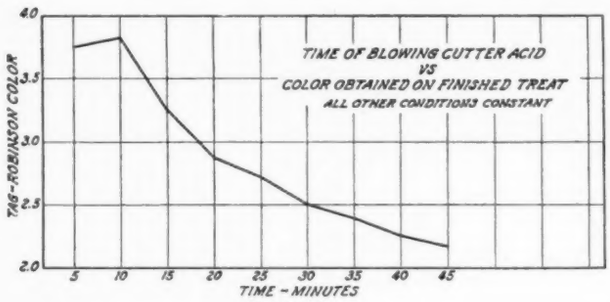

FIGURE 6

caustic solution or water to aid in the separation. The larger particles thus formed settle rapidly and there is less pepper sludge left entrained in the oil.

Thirty minutes after agitation has been discontinued, sufficient sludge has settled to begin drawing it off. This drawing-off process will require three to four hours for its completion. It is necessary to decrease to a minimum the time of contact between the sludge and the treated oil.

Care must be taken that the sludge does not take too long a time to settle, as it hardens rapidly and, if not kept moving, it soon becomes impossible to draw it off.

The minute particles of sludge commonly called "pepper sludge" are a constant source of trouble to the treater. This "pepper" will not settle at the temperature of the oil and heating to accelerate its precipitation is prohibited, due to the harmful effects of heat mentioned in an earlier part of this paper. This pepper has a definite bearing upon the color obtained with a given quantity of clay. More clay will be necessary to obtain a given color when there is "pepper sludge" present in the oil to be contacted.

The data below show colors obtained on the same oil, one containing "pepper sludge," the other free of "pepper

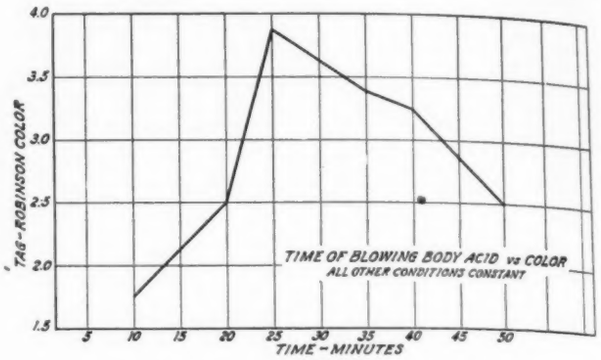

FIGURE 7

sludge." The same quantity of clay was used on each sample:

Oil containing pepper	1¾ T. R.
Pepper-free oil	4 T. R.
Oil heated to 200° to settle pepper	1½ T. R.
Oil heated to 115° to settle pepper	3½ T. R.

A poor color is obtained when the acid oil containing "pepper sludge" is contacted, because a portion of the clay will neutralize and absorb this finely-divided sludge and is lost for improving the color of the oil. It is impossible to heat the oil, thereby settling this pepper, as shown in the above table, because the oil will then be darkened by re-solution of the sludge particles. If settling is employed for the removal of "pepper sludge" it must be done at low temperatures. This process is usually too slow, as an agitator will be held up for ten or twelve hours.

Several of the physical properties of the oil have been affected by this acid treatment. The color is considerably lighter than that of the crude product and generally more so as the treating is carried out with larger quantities of acid. Generally after the acid treatment the oil has a brown to bluish cast and it is only after neutralization that the oil changes and takes on the lighter color.

We find the carbon residue also improved. Other properties affected are the gravity and viscosity of the oil, both of which are lighter, due to the removal of the heavy tarry and asphaltic bodies, and for the same reason we find a much improved carbon residue on the product.

There have been in the past many attempts made to improve the sulphuric acid treatment by the substitution of other chemicals, but as yet none has been found adaptable to the heavy oil treatment. Aluminum chloride is used with success as a substitute for sulphuric acid treatment, but its use is not general, for the cost is not comparable with acid treatment.

The future developments seem to be in the field of continuous treatment whereby the oil is violently contacted with acid in mechanical contactors and the resultant sludge separated by centrifugal means. The success of this seems to depend on the use of smaller amounts of acid than is usual or upon treatment in solution. Undoubtedly under the present methods more acid is used than is necessary; yet if more violent contact between the oil and the acid is obtained, sludge separation seems impossible. The whole subject is one of the laggards of the refining industry and we are just beginning to make some headway toward a scientific solution of the problem.

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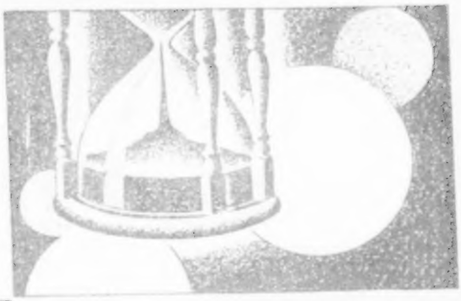

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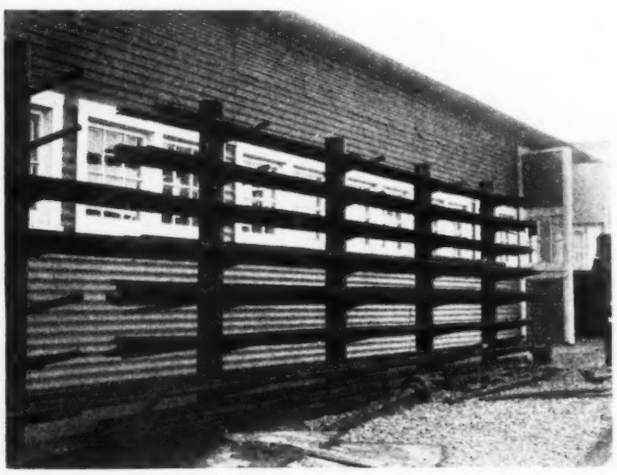


Rack outside shop for storing rods.

The entire framework of the building is of old junk pipe, previously used in the oil fields, welded together and heavily braced. The wall studs are of six-inch diameter pipe fastened to the solid concrete floor by means of bolts set in the concrete when fresh and soft. The top of the studs are welded to a three-inch pipe making a complete circle of the building, running immediately under the eaves, and to the rafters, also made of pipe. All of the rafters are braced to the studs by an angled piece of pipe running from a point a few feet down on the studs to a point on the rafters away from the wall. At each corner of the shop a horizontal cross-wise pipe member gives additional strength and support. This is the type of structure which offers strength and endurance, elimination of much vibration and sway, yet carries out the idea of salvageability that was in the minds of the company men. The roof even has received special attention. It is of the rounded type, or arch style, and gives greater protection from the wind in that there is no flat surface to catch the force of the wind. In addition to the iron pipe rafters and cross-members that support the roof, additional pieces of old rig irons and sucker rods have been used in the network of braces. The rafters are two inches thick and were bent and welded in the desired round pitch, a bend of five feet, by the company's own welders.

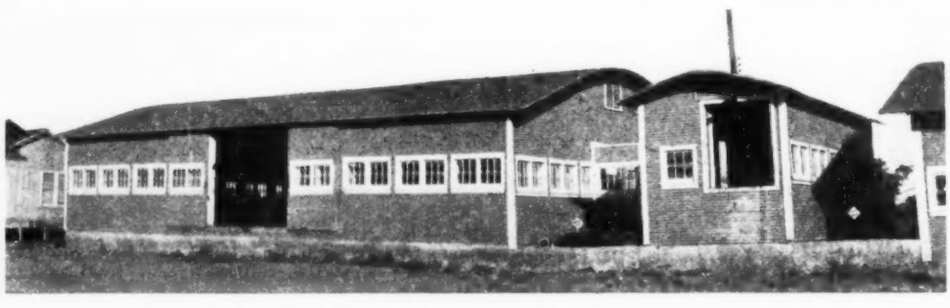
The entire house, including the roof, is sided and shingled with corrugated iron. The sheets of corrugated iron were put on horizontally, or, in other words, circling the building, rather than following the customary vertical style of putting such sheets on for siding. In this way the full 10-foot length of the sheets has been used without cutting, since the doors and windows have been spaced to eliminate as much of this as possible.

This is a very important item. If the company should ever decide to tear the building down the full length of the siding, as it was bought, would be available instead of the usual short odds and ends which often cannot be used. The doors are made of drop siding, painted gray like the sides of the shop, and on the outside give the same appearance as the painted corrugated iron sheeting.

Working Conditions

The working conditions in the shop are ideal. The building is constructed so as to offer warmth in the winter, coolness in the summer, excellent natural light and safety for the workmen.

The sides of the building, in addition to being finished with the iron sheets on the outside, are also lined on the inside with the same material. This forms a dead air space of six inches between the two walls. This dead air space adds much to the warmth of the building in the winter and lessens the heat in the summer season. Furnaces made of old oil cans aid in heating the shop in the cold seasons of the year. The shop has a very unusual natural lighting system. The full benefit of the sun's light has been secured without the customary glare of rays, and with less expense than ordinarily necessary in a building of this size. A solid string of win-



The machine shop at Drumright.

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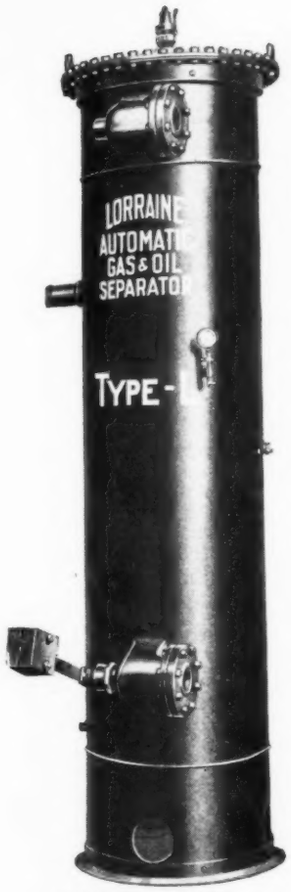

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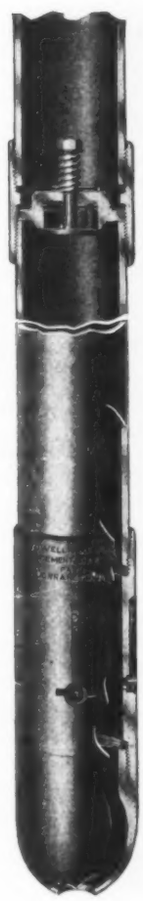

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dows surrounds the building, which is 60 x 40 feet. A feature of the window installation is that each is of the single, or half-window type instead of the usual double-window.

The use of the single window has eliminated about one-half of the window space and the subsequent cost, yet full lighting is secured and without glare. The windows have been placed at the right height so that by the time the men come to work in the morning the rising sun has reached a point at which its rays do not come in the east side, yet light is thrown directly upon the working machines. The same principle applies with regard to the setting sun — by the time it is low enough to shine in the west windows the day's work is completed.

A continuous circle of windows around the shop removes all dark spots. E. L. Bell, transportation and machine shop superintendent at Drumright for the Deep Rock Company, and well known in Mid-Continent A. P. I. circles as "Ernie", states that only once has it been necessary to use the artificial lighting system in the daytime and that was one afternoon during a storm. Mr. Bell is the principal designer of the building.

The windows are arranged to drop down on the inside of the walls when they are desired open for ventilation purposes. When lowered they are out of the way where there is not much possibility of their being broken. The glass in the doors corresponds to that in the walls so that, when the sliding doors are open, no light is cut out.

When the machinery was being set it was placed to receive the maximum amount of light, and to give as much working space as possible. Each machine, with the exception of one small one has been placed back against the wall. This leaves the center of the floor clear for articles of equipment being worked on, and also places the mechanism in the best light conditions offered.

One electric 10-horsepower motor drives all machinery in the shop, with the exception of the pipe machine. This is accomplished by a series of belts and pulleys. The pipe machine, at one end of the shop, is operated by an individual motor, allowing the remainder of the works to be idle while it is working.

The safety idea is carried out to the fullest degree in the operation. One controller starts the machinery, except the individual pipe machine motor, but there are three convenient places for turning off the electric current and stopping all of the machines. These three switches are placed so that they are handy on any side of the shop. Thus, if anything goes wrong in any part of the shop these switches are easily and quickly reached by the men. However, the machines cannot then be started until the main switch is again thrown on. This switch is at one end of the building and practically automatically causes a man to look over the shop and in doing this he will see if every man is clear of the moving parts of the machines before turning on the electric current. The belts running to the machines from the overhead transmission belt system are covered with guards to protect the workmen from these articles in case of a break or slip.

In each corner of the shop the inside wall of corrugated iron has been left off between the last studs. This hollow space contains shelves for the storing of small tools, oil, and other necessary small items. The building of the shelves into the wall conserved floor space.

The work of the shop is to take all surplus equipment from the production department in the Drumright and Seminole areas of Oklahoma, which constitute the major active portion of the state, and to repair them for further use in the field. Some equipment from the gasoline and pipe line divisions is also overhauled. The equipment may be anything from fittings, gates, and pipe to mud hogs and pumping units. Pipe up to 12-inch is cut and rethreaded, cylinders rebored, the company's own rings made and installed, and complete overhauling done. This work represents quite a saving to the company.

Adjoining the main shop on the south is a small narrow building, called the cleaning house, which contains four bins holding various solutions for celaning purposes. The cleaning of the equipment permits better and closer inspection to determine the flaws, and makes the equipment easier to handle.

Outside crane track for moving big equipment.

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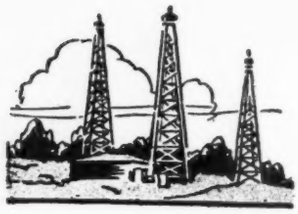


MODERN UNITS Pumping Operations *in*

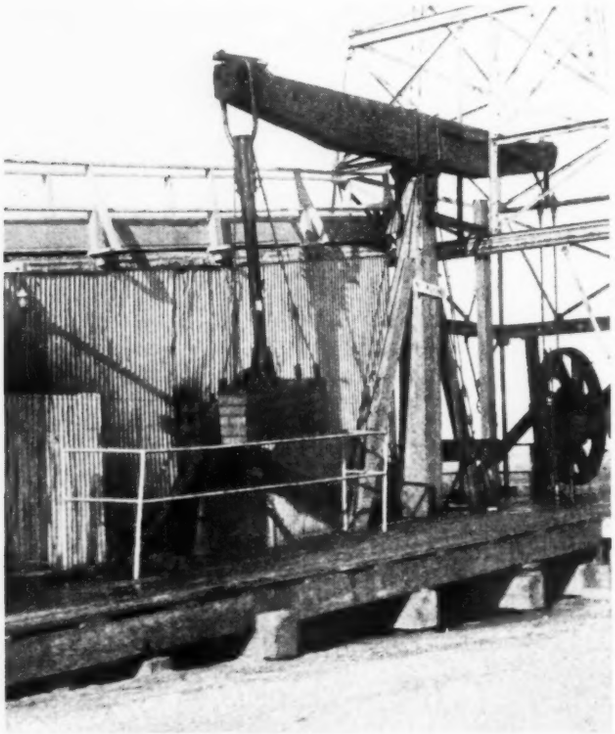
THE Greater Seminole area of Oklahoma has been a proving ground for a great many devices designed to facilitate crude oil production, and pumping equipment has come in for its share of attention. Many new and improved pieces of pumping equipment have been installed and tested and a large number of these have proven successful in actual operation.

At the time pumping operations were begun at Seminole it was the deepest producing district in the state, having an average depth of 4,200 feet per well. It is still the deepest field being pumped to any appreciable extent. This fact, together with water encroachment (which occasioned heavier lifting loads and caused some corrosion) and crooked drilling of holes, has resulted in excessive wear on pumping machinery—the principal factor in the large amount of downtime and consequent loss of production.

Cups, working barrels and sucker rods have been subjected to the greatest portion of the burden because of their movement in the hole, but other pumping installation parts have also suffered. Extraordinary care is necessary in the installation and operation of all pumping units because of the unusual and irregular characteristics of the field. The results obtained in such cases might be considered testimonials for the manufacturers of equipment and the engineers of the producing companies.

Every well in the field offers an individual problem and in many instances much experimenting has been necessary before the most desirable hook-ups have been obtained. Some wells are easy pumpers, while others give an unusual amount of trouble. There is no predetermined method of foretelling the characteristics of the wells in this area.

One of the principal evils in pumping operations has been heavy water encroachment upon the producing sands. This has caused corrosion as well as increased loads on sucker rods to add to the pumping troubles of operators. Gas in the Seminole pools contains some sulphur which sets up a corrosive action when accompanied by water. In such wells tubing, rods, cups, working barrels, pumps and even polished rods have suffered. A few companies are using special alloy steel rods and tubing to combat these corrosive conditions.



Seminole has long been known as a field of extremely crooked holes. There has, naturally, been excessive wear on tubing, rods and cups in their up-and-down motion in wells. Some have been equipped with tubing collar protectors and others with sucker rod guides for the purpose of reducing wear on sucker rods and tubing. These guides are made of wood, brass, cast iron and other substances. In a few extremely crooked holes guides have been placed at every joint of the rod.

One company, the Pure Oil Company, pumped a well having a very crooked hole, with a wire line in lieu of the customary rods. The test was quite successful. The cups were clamped on a one-and-one-eighth-inch diameter wire line pumped by a regular beam powered through a 40-horsepower engine.

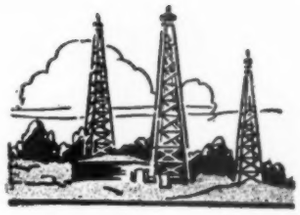
Sand has also been injurious to pumping equipment. Sand generally makes its appearance in very large quantities and this condition is not limited to any one section of the field. Often a single well in one sector will give sand troubles while its offsets have no appreciable amount of sand.

Several wells in the pool have been produced by a combination method of pumping and flowing by air-gas lift, and several are now operating on this plan. This was

Above — A Seminole pumping well. Right —Pure Oil Co.'s central power at Maud.

ADOPTED *for* Seminole Field

By WARREN L. BAKER



generally used where large quantities of water and little oil were present. There are several methods used in hooking up these wells.

One method is to set a wall packer, above the sand, between the tubing and casing or liner. The tubing is perforated above the packer and gas or air introduced between the tubing and casing and permitted to enter the fluid column through the perforated tubing, thus lightening the column and reducing the load on the pump.

Tubular sucker rods have also been used in experimentation with combination flowing and pumping wells. One particular well used 0.957-inch inside diameter and 1.315-inch outside diameter rods. The perforated joint was placed 40 feet above the traveling valve in two-and-one-half-inch tubing. Approximately 800 pounds per square inch air pressure was required to keep the well flowing. The input air volume per day was 331,000 cubic feet. The average daily production of oil before air was introduced was 41.5 barrels, and this increased to 131 barrels per day on the combination method. A dynamometer showed that at 18 strokes per minute, 42-inch strokes, the well required 14.5 horsepower for ordinary pumping and 6.85 horsepower for combined pumping and flowing.

A few companies have placed back pressure on their pumping wells, although this practice has not been generally adopted. In many cases back pressure proved successful in eliminating trouble, especially in wells which were making water. It also aided in retarding the water encroachment.

Most of the wells in Greater Seminole are on the pump, the majority being pumped on the beam from individual powers. There are, however, a few central power stations and a number of pumping jacks in use.

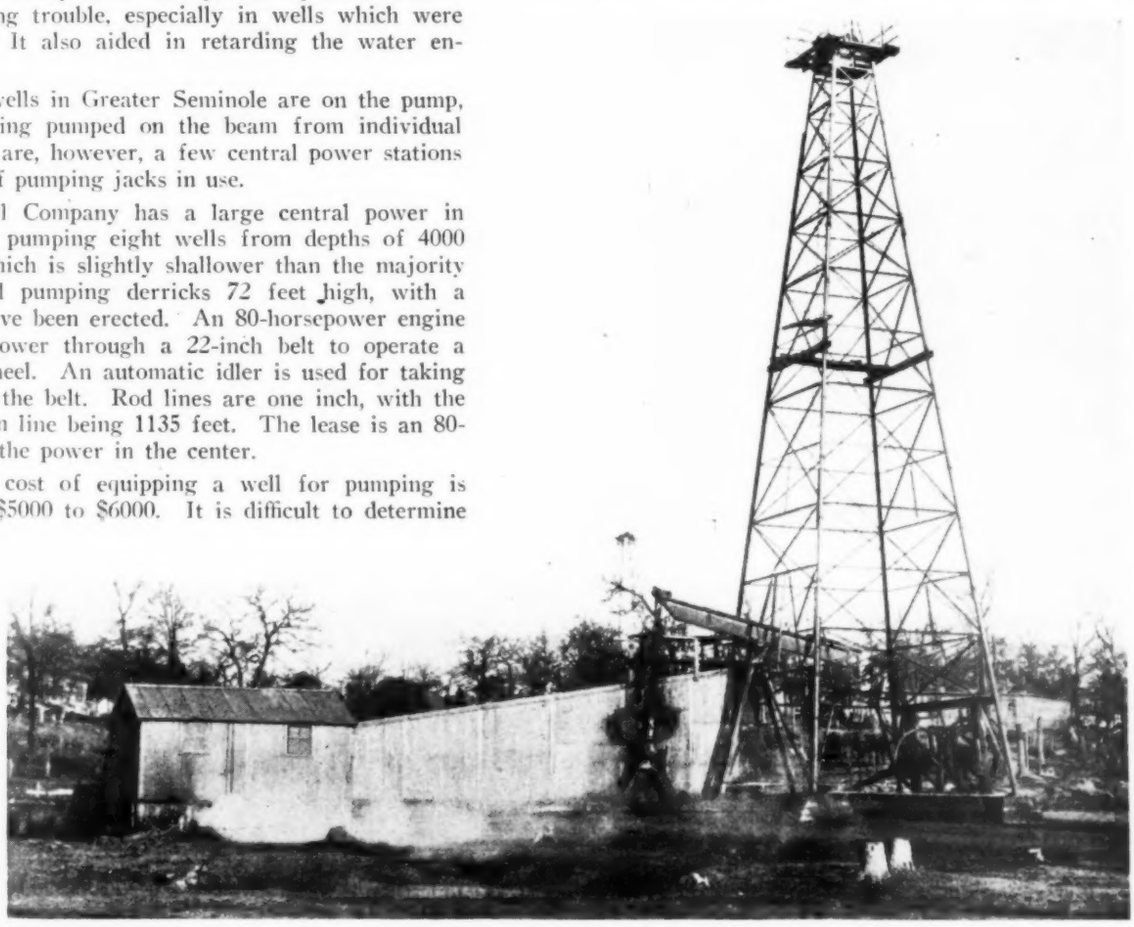
The Pure Oil Company has a large central power in the Maud field, pumping eight wells from depths of 4000 to 4100 feet, which is slightly shallower than the majority of wells. Steel pumping derricks 72 feet high, with a 20-foot base, have been erected. An 80-horsepower engine transmits the power through a 22-inch belt to operate a 30-foot band wheel. An automatic idler is used for taking up the slack in the belt. Rod lines are one inch, with the longest unbroken line being 1135 feet. The lease is an 80-acre tract with the power in the center.

The average cost of equipping a well for pumping is probably from $5000 to $6000. It is difficult to determine the average lifting cost of Seminole crude, the various companies using different methods for compiling this information. The cost also varies to an unusually large degree on wells, depending upon the amount of production, downtime and labor charges, and the items charged against the well. There have been examples of very economical lifting cost, also some of unusually high cost.

The rotary drilling derrick has, in many instances, been left in place to serve after the well is on the pump, while in others it is replaced with a shorter one. In the early drilling period there was a shortage of rotary derricks and many of these were moved for drilling other holes. The chief advantage of leaving the rotary derrick in place is the saving of time in pulling tubing and rods.

Prime movers for pumping are generally of the gas or electric type. The gas engines range in size from 25- to 55-horsepower, except in cases of central powers, with the 35- or 40-horsepower, single-cylinder gas engine the most common. Electric motors are of the 50/20- and 65/25-horsepower, two-speed type. Power from electric motors is transmitted either through reduction gear units or through a countershaft and belt to the band wheel. The gear type unit is widely used and has proved itself adaptable to Seminole pumping requirements.

Heavy duty reverse gear clutches or countershafts have



Installation of a pumping well at Seminole.

been used to advantage in this field, and in addition to the countershafts many of the installations have an outboard bearing on the engine drive shaft to minimize the end thrust on the driving side.

A great many steel walking beams, pitmans and band wheels are being used. The usual walking beams are 12 x 14 inches by 26 feet, used in conjunction with 11-foot diameter band wheels and the A. P. I. standard four-hole crank. These installations give the following lengths of stroke: First hole, 24 inches; second hole, 34 inches; third hole, 44 inches, and the fourth hole, 54 inches. Some six-hole cranks are in operation and give strokes from 22 to 72 inches. The average length and speed of stroke are about 42-inch, and 18 to 20 strokes per minute. One company in particular is trying slow pumping operation, and with considerable success.

The polished rods are ordinarily one and one-quarter-inch diameter by 11 feet. Virtually every well is equipped with a straight lift beam hanger. A. P. I. standard rig irons are in general use.

The tubing is generally two or two and one-half inches in diameter. Two-inch tubing is usually used in wells cased with 5⅜-inch casing and two-and-one-half-inch tubing in wells cased with 6⅝-inch casing.

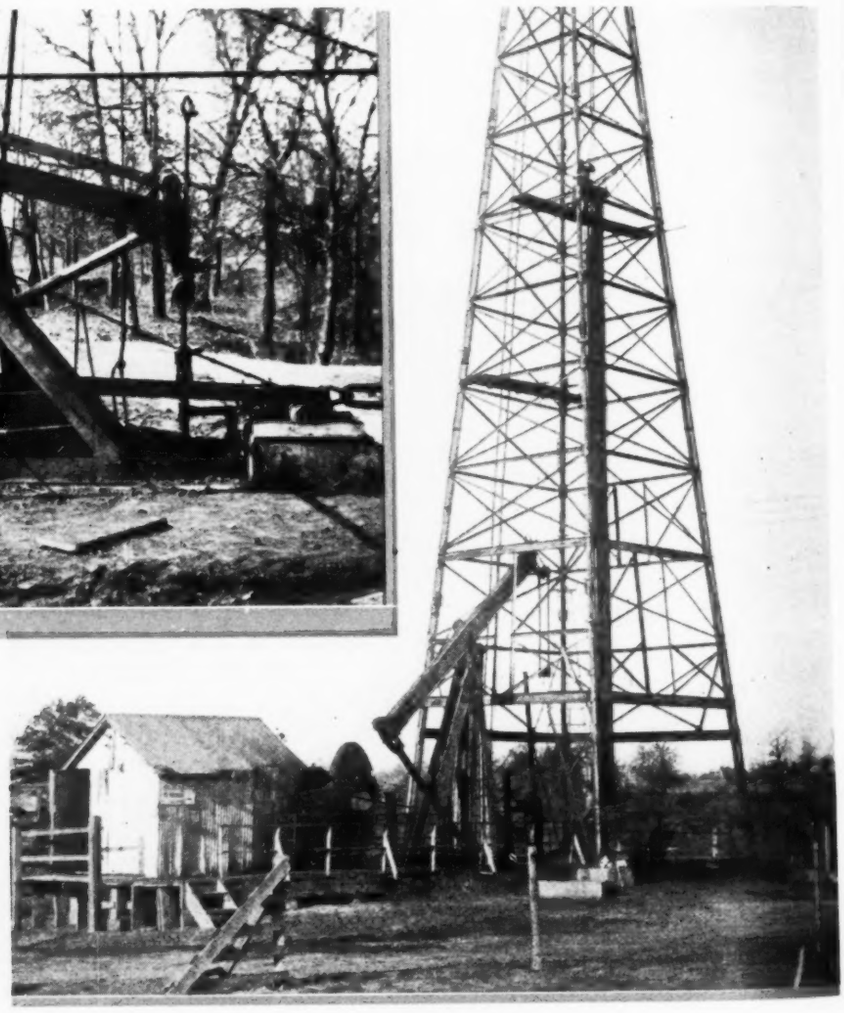
Nearly every well in the district is equipped with counterbalances. Several types are in use. There is no set practice for determining the weight of the counterbalance and oftentimes weight is merely added until a smooth pumping motion has been obtained. Some wells are counterbalanced after the load on the beam hanger has been determined by a dynamometer. Several types of dynamometers and weight indicators are used at Seminole.

Virtually every kind of pump manufactured is in use by Seminole operators. Many of these pumps are of recent design or incorporate improved features. Working barrels of every type and description are to be found. The most common working barrels are two and one-half inches by ten feet, or two and one-half inches by fifteen feet.

A combination sand trap and gas anchor is used on nearly every pumping installation.

A large force of men in the district are kept busy pulling rods. This may be expected in an area having about 2,500 producing wells and where pumping conditions are no more favorable than they are at Seminole. Because of the strain upon rods in Seminole wells, the operating companies are making an effort to take the best of care of this equipment. In hauling rods it is general practice to use metal protectors to prevent the battering of the threads, which otherwise might cause a tight make-up in running.

Generally speaking, equipment in operation at Seminole is of the finest type pumping machinery on the market today. It is to this, and constant care and attention, that much of the success in pumping the Seminole wells is due. The size and sturdiness of pumping equipment are very much in contrast with many former units, and doubtlessly there will be many additional improvements designed, tried, and perhaps proven during the life of this great field. The knowledge which has been gathered from the performance of these wells will, in the future, be a basis for the perfection of new ideas and improved pumping machinery.



Above — Pumping jack installation. Right—A crew pulling rods.

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Some Suggestions for
Centrifugal Pump Operation

By JOHN M. McGREGOR*

THE past year has seen considerable progress in the design of centrifugal pumps, especially those used for pipe line service. Several automatically controlled stations of the electric-centrifugal type are now in use, but, whether the stations be automatically or manually controlled, until greater flexibility over a wide range of oil deliveries can be secured the use of the centrifugal pump station is more or less limited.

It has been the usual practice to have two pumps in series, both pumps being similar regarding pressure and capacity, and built for a particular service—that is, a definite number of barrels of oil per hour against a certain pressure. Such an arrangement is ideal if operations are confined to the predetermined head and capacity, but when operating under conditions other than those for which the units are built, the centrifugal pump compares unfavorably with its rival.

In order to eliminate the necessity of working units against partially closed gates and to make possible complete automatic control of a pipe line over a wide range of deliveries, the scheme described below has been worked out.

The table shown is set up for a theoretical pipe line consisting of 258.3 miles of 12-inch line. Seven stations have been laid out and these are spaced as shown. The curves show the performance of the three pumps which are installed in each station and it is from the originals of these curves the various points were plotted.

The installation consists of three pumps—the pump at suction end of station being a single stage pump of equal capacity to the multistage units. This pump is referred to as "C" and is built to withstand whatever residual pressures may be encountered. The two multistage pumps are similar in every respect, with the exception that they have different diameter impellers fitted. These pumps are referred to as "B" and "A." To secure the desired results, the only addition to the present accepted installations is that of the single stage unit. No allowance for stand-by units has been made, but these can be readily arranged accordingly to the ideas of the operating company.

Whatever may be the extra cost of installing the single stage unit, it is believed it will soon be more than counterbalanced by the saving effected in various ways, particularly because the pressures can be regulated so that the total amount required to move a certain quantity of oil through the line can be built up without any loss due to unnecessary residual pressures at the receiving end of the line. In the example worked out as shown on table, the initial suction pressures, whatever they might be, were ignored, and it was decided to arrive at the receiving end with a pressure as close as possible to zero. A glance at the last column will show that the greatest residual pressure secured at the terminal point is only nine pounds, showing how closely one can calculate the operations for an entire line.

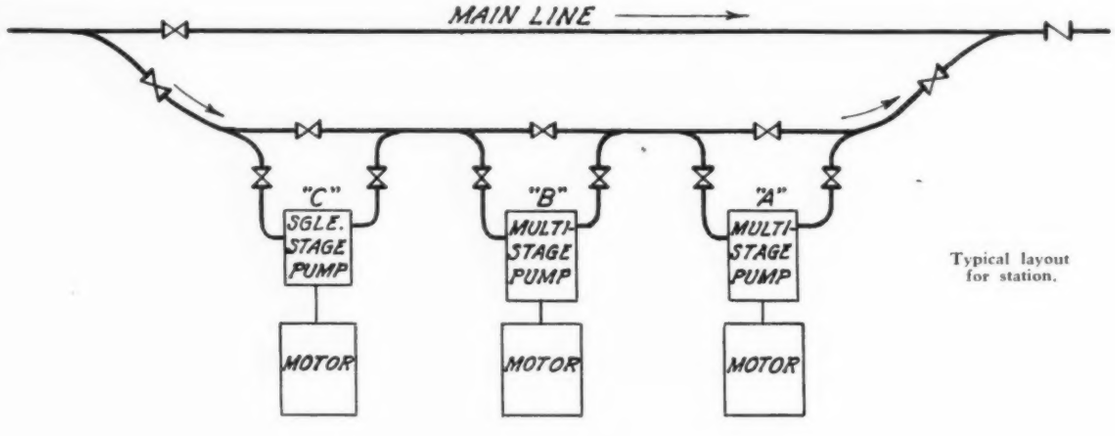
It is not suggested that the sheet shown need be used by the chief oil dispatcher or whoever may be responsible for the operation of the line. The table given is the form used in working up the necessary data, but for control purposes all that is necessary is to show the capacities and the pumps to be used at the various stations.

By an installation such as is suggested, quite a variety of pressure conditions can be secured. The pumps can be operated as follows: (1) Pump "C" only; (2) pump "B" only; (3) pump "A" only; (4) pumps "C" and "B" in series; (5) pumps "C" and "A" in series; (6) pumps "B" and "A" in series; (7) pumps "C," "B" and "A" in series.

In order to illustrate how the various figures are arrived at, it might be well to analyze briefly the tabulation. The first column shows the number of barrels to be pumped hourly, and the loss in pressure per mile when delivering oil of 38 degrees Bé gravity. The second column shows the total pressure required to deliver the amount of oil shown in column one through the length of line between the different stations as shown at top. The efficiency of the pumps is also shown in second column. The efficiency is taken directly off the curves and where pump "C" is used in series with "A" or "B" (the efficiencies of these being similar), the average efficiency is shown.

Column No. 3, headed "Residual Pressure," "Pumps Used," "Total Pressure," shows "R. P." (residual pressure), the pump to be used, and "T. P." (total pressure). The headings for columns two and three are carried out for the number of stations on the line, and the last column, headed "Residual Pressure, Receiving End, Pounds Per Square Inch," shows what pressure is left at the discharge of the last pump of the terminal station.

*Engineer, Taubman Supply Corp.



Typical layout for station.

12" LINE TOTAL LENGTH 258.3 MILES

Barrels Per Hour Pressure Per Mile	Station No. 1 37.9 Miles			Station No. 2 35.6 Miles			Station No. 3 35.8 Miles			Station No. 4 37.4 Miles			Station No. 5 36.5 Miles			Station No. 6 37.1 Miles			Station No. 7 38.0 Miles			Resid. Press. Receiving End Lb./Inch2
	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	Line Press. Eff. %	Resid. Pumps Total	Press. Used Press.	
1000 3.60 lb.	137 70	R.P. "A" T.P.	0 385 385	128 70	R.P. "B" T.P.	248 345 593	129 74	R.P. "C" T.P.	465 102 567	135 74	R.P. "C" T.P.	438 102 540	132	R.P None	405 405	134	R.P. None	273 273	137	R.P. None	139 139	2 lb.
1100 4.19 lb.	159 73	R.P. "B" T.P.	0 340 340	149 73	R.P. "B" T.P.	181 340 521	130 75.5	R.P. "C" T.P.	372 101 473	157 75.5	R.P. "C" T.P.	323 101 424	153 75.5	R.P. "C" T.P.	267 101 368	156 75.5	R.P. "C" T.P.	215 101 316	159	R.P. None T.P.	160 160	1 lb.
1200 4.90 lb.	186 76	R.P. "B" T.P.	0 335 335	175 76.9	R.P. "B" "C" T.P.	149 335 101 585	176 77.8	R.P. "C" T.P.	410 101 511	183 77.8	R.P. "C" T.P.	335 101 436	179 77.8	R.P. "C" T.P.	253 101 354	182 77.8	R.P. "C" T.P.	175 101 276	186 77.8	R.P. "C" T.P.	94 101 195	9 lb.
1300 5.60 lb.	212 78.8	R.P. "A" "C" T.P.	0 371 101 472	199 78.5	R.P. "C" T.P.	260 101 361	201 78.8	R.P. "A" "C" T.P.	162 371 101 634	210 78.5	R.P. "C" T.P.	433 101 534	204 78.5	R.P. "C" T.P.	324 101 425	208 78.5	R.P. "C" T.P.	221 101 322	213 78.5	R.P. "C" T.P.	114 101 215	2 lb.
1400 6.40 lb.	242 80.4	R.P. "B" "C" T.P.	0 320 100 420	228 79.8	R.P. "C" T.P.	178 100 278	229 80.4	R.P. "B" "C" T.P.	50 320 100 470	239 79.8	R.P. "C" T.P.	241 100 341	234 80.4	R.P. "B" "C" T.P.	102 320 100 522	238 79.8	R.P. "C" T.P.	288 100 388	243 79.8	R.P. "C" T.P.	150 100 250	7 lb.
1500 7.20 lb.	273 83	R.P. "B" T.P.	0 313 313	256 81.8	R.P. "B" "C" T.P.	40 313 100 453	258 80.5	R.P. "C" T.P.	197 100 297	269 83	R.P. "B" T.P.	39 313 352	263 83	R.P. "B" T.P.	83 313 396	267 83	R.P. "B" T.P.	133 313 446	274 80.5	R.P. "C" T.P.	179 100 279	5 lb.
1600 8.05 lb.	305 84	R.P. "A" T.P.	0 348 348	287 84	R.P. "A" T.P.	43 348 391	288 84	R.P. "A" T.P.	104 348 452	301 84	R.P. "A" T.P.	164 348 512	294 84	R.P. "A" T.P.	211 348 559	299 84	R.P. "A" T.P.	265 348 613	306	R.P. None T.P.	314 314	8 lb.
1700 8.90 lb.	337 84.5	R.P. "A" T.P.	0 340 340	316 84.5	R.P. "A" T.P.	3 340 343	319 84.5	R.P. "B" T.P.	27 296 323	333 82.8	R.P. "A" "C" T.P.	4 340 99 443	325 82.8	R.P. "B" "C" T.P.	110 296 99 505	330 82.8	R.P. "B" "C" T.P.	180 296 99 575	338 81	R.P. "C" T.P.	245 99 344	6 lb.
1800 9.80 lb.	371 82.8	R.P. "A" "C" T.P.	0 334 99 433	349 82.8	R.P. "A" "C" T.P.	62 334 99 495	351 84.5	R.P. "A" T.P.	146 334 480	367 84.5	R.P. "A" T.P.	129 334 463	358 84.5	R.P. "A" T.P.	96 334 430	364 84.5	R.P. "A" T.P.	72 334 406	372 84.5	R.P. "A" T.P.	42 334 376	4 lb.
1900 10.78 lb.	408 84.5	R.P. "A" "B" T.P.	0 324 282 606	384 84.5	R.P. "A" T.P.	198 324 522	386 84.5	R.P. "A" T.P.	138 324 462	403 84.5	R.P. "A" "B" T.P.	76 324 282 682	394 84.5	R.P. "B" T.P.	279 282 561	400 84.5	R.P. "A" T.P.	167 324 491	409 84.5	R.P. "A" T.P.	91 324 415	6 lb.
2000 11.80 lb.	447 84	R.P. "A" "B" T.P.	0 317 270 587	420 82	R.P. "A" "C" T.P.	140 317 97 554	423 84	R.P. "A" T.P.	134 317 451	441 84	R.P. "A" "B" T.P.	28 317 270 615	431 84	R.P. "A" T.P.	174 317 491	438 82	R.P. "A" "C" T.P.	60 317 97 474	448 82	R.P. "A" "C" T.P.	36 317 97 450	2 lb.
2100 12.82 lb.	486 83	R.P. "A" "B" T.P.	0 306 257 563	456 83	R.P. "A" "B" T.P.	77 306 257 640	459 80.5	R.P. "A" "C" T.P.	184 306 96 586	479 83	R.P. "A" "B" T.P.	127 306 257 690	468 83	R.P. "A" T.P.	211 306 517	476 83	R.P. "A" "B" T.P.	49 306 257 612	487 80.5	R.P. "B" "C" T.P.	136 257 96 489	2 lb.
2200 13.92 lb.	528 82	R.P. "A" "B" T.P.	0 290 246 536	495 82	R.P. "A" "B" T.P.	8 290 246 544	498 82	R.P. "A" "B" TP.	49 290 246 585	521 82	R.P. "A" "B" T.P.	87 290 246 623	508 82	R.P. "A" "B" T.P.	102 290 246 638	517 82	R.P. "A" "B" T.P.	130 290 246 666	529 79	R.P. "A" "C" T.P.	149 290 95 534	5 lb.

Should residual pressure be desired, it is a simple matter to arrange the pump operations to meet whatever condition is wanted.

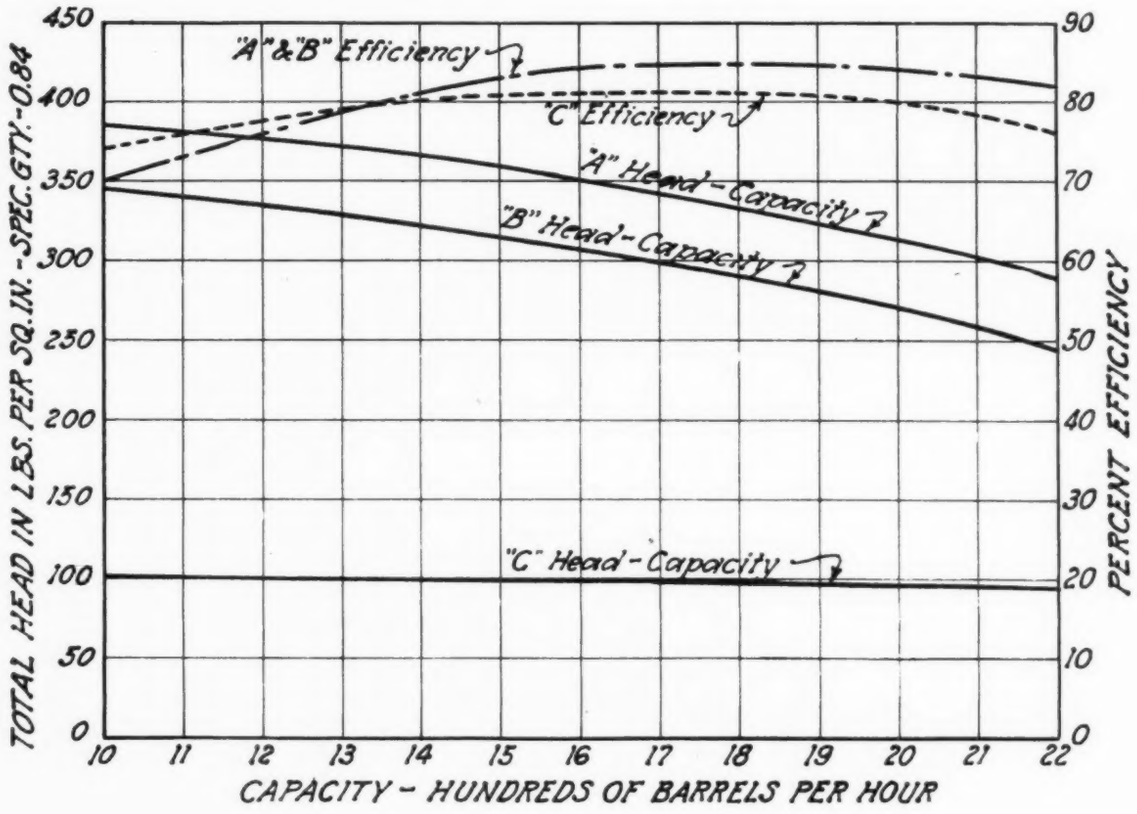
It is generally known, and yet it might be mentioned, that a centrifugal pump takes whatever pressure may be delivered to the suction and adds to it whatever pressure it makes; for example, if a pump is capable of delivering a certain quantity of fluid against a pressure of 100 pounds per square inch, should there be two pounds on the suction, the total discharge pressure would be 102 pounds. Should there be 100 pounds on the suction, the total discharge pressure would be 200 pounds. In view of this fact it will be seen that whatever surplus energy is used at one station it is taken advantage of at some other. To illustrate, under station No. 6, when delivering 1,600 barrels an hour, there is an incoming pressure from station No. 5 of 265 pounds—almost sufficient to permit station No. 6 being by-passed. However, if pump "A" be run, 348 pounds is added, making a total of 613 pounds. Only 299 pounds are required, which gives a residual pressure of 314 pounds at station No. 7. It requires 306 pounds to deliver the oil to the terminal point, and there is a residual pressure of 314 pounds, therefore, the last station need not be operated and the oil arrives at the terminal point from station No. 6, with a final pressure of eight pounds. When it is considered that the total line pressure is 2,080 pounds, it will be seen that the percentage of power lost in producing the extra eight pounds is extremely small.

In order to determine what pumps are to be used, it has to be borne in mind, in the example cited, that there are only three pumps in each station, only a total of seven of each type of pump on the line, and that the line pressure must not exceed, say, 700 pounds.

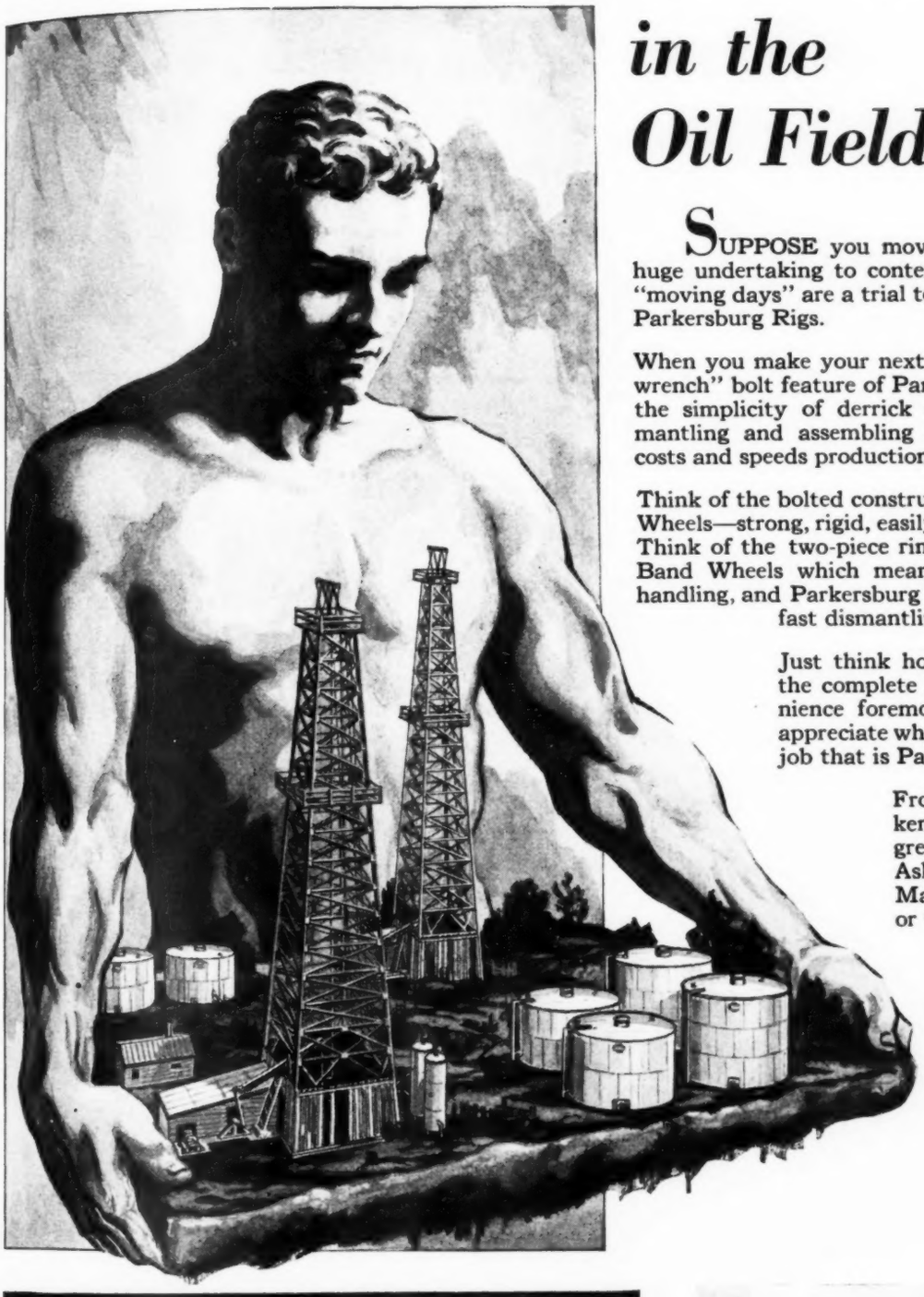
In conclusion, it might be well to illustrate the manner in which the pump selection is made, assuming it is required to determine the arrangement necessary to deliver 2,000 barrels per hour. First of all it is required to find the total line pressure—in this case 3,048 pounds, found by multiplying the pressure per mile, 11.8 pounds, by the total length of the line, 258.3 miles, or by adding the various pressures between stations, 447 pounds, 420 pounds, et cetera. The next step is to examine the curves of the three pumps and see what pressures are secured. In this case they are: "C", 97 pounds; "B", 270 pounds; "A", 317 pounds. The various combinations are then worked out. It would be found that seven "A" would give 2,219 pounds, obviously too low. However, if two "B" were added, a total of 2,219 + 540 = 2,759 pounds is secured, but this is still too low. If three "C" be added the total would be 2,759 pounds + 291 = 3,050 pounds, or just two pounds over the total line pressure required. Thus it would be decided that to deliver 2,000 barrels an hour it would be necessary to use seven "A", two "B" and three "C" pumps. Having found the necessary pumps, it is an easy matter to make the selection for the various stations, bearing in mind there is only one pump of each kind at a station and that the pressure must not exceed the figure stated previously. Incidentally, examination of the table will show that the highest pressure encountered is 690 pounds when delivering 2,100 barrels an hour from station No. 4 to station No. 5.

A somewhat similar performance sheet can be compiled should the centrifugal pumps be driven by engines. Instead of varying the pressures by means of pumps capable of producing different heads, the engine speeds can be plotted, care being taken to see that the arrangements are such that the speeds are kept within the range supplied by the manufacturers and that the required horse power can be developed at the necessary speed.

The author desires to acknowledge the work of A. H. Hollander, chief engineer of the Byron Jackson Pump Co. of Berkeley, Calif. When working up some data for a pipe line company and putting forward certain suggestions to Mr. Hollander, the latter drew up the original work sheet along the lines of the one shown, however, it was not possible to obtain the close results at all capacities until it was suggested by W. R. Reed, master mechanic of Sinclair Pipe Line Co., that a single stage pump be used.



MOVING DAY



in the Oil Fields

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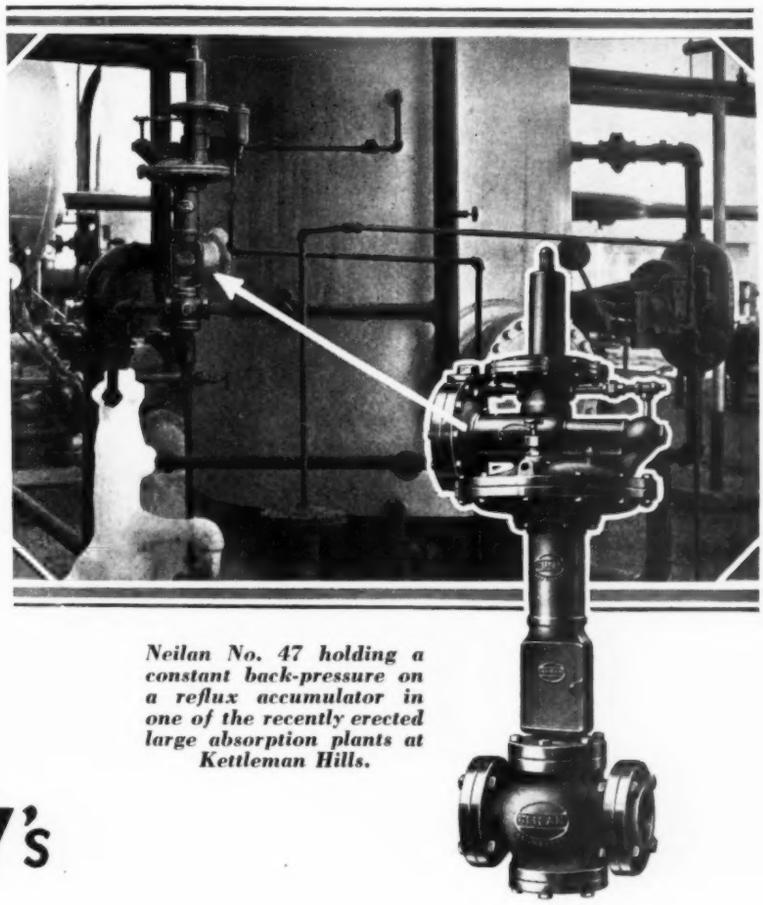
Strange ~ but True ~ ~ ~ ~ Happenings in the Petroleum Industry

PENNSYLVANIA : UP IN THE HILLS NOW COVERED BY MANY OIL WELLS, A TEST ON TOP OF A HILL CAME OUT THE SIDE INTO A PRESSURE STORAGE TANK OF A BREWERY (IN THE GOOD OLD DAYS). THE DEPTH WAS ABOUT 400 OR 500 FEET. THE BEER FOAMED OUT OF THE TOP OF THE WELL. THE CREW HAD A BEER PARTY THE REST OF THE DAY. ~ ~ ~ ~ ~
BREWERY
IN 1916 THE GULF COAST OIL CORP., STRUCK GAS IN A STRAY SAND AT 900 FEET. THE 8 1/4 INCH CASING HAD BEEN SET AND ONE ROCK BLOWN FROM THE HOLE MEASURED 10 1/4 IN., ACROSS ITS SMALLEST DIAMETER. THIS WAS TWO INCHES LARGER THAN THE DIAMETER OF THE CASING THRU WHICH IT HAD PASSED. ~ Submitted by Frank Carothers Houston, Texas.
WHEN ONE OF THE LARGE ENGINES IN THE OKLAHOMA NATURAL GAS CORPORATIONS KELLYVILLE OKLA., STATION STARTED MISFIRING AND HAD TO BE SHUT DOWN, THE CREW AFTER A HASTY CHECK FOUND THE TROUBLE ORIGINATED IN A MIXING VALVE. INVESTIGATION REVEALED A CURIOUS WOOD PECKER FLEW TOO CLOSE TO THE AIR INTAKE LINE AND WAS SUCKED THROUGH IT INTO THE VALVE.
JR.

CONSTANT BACK PRESSURES *on* STABILIZER REFLUX

assured with NEILAN №47's



Neilan No. 47 holding a constant back-pressure on a reflux accumulator in one of the recently erected large absorption plants at Kettleman Hills.

The growing demand for Neilan Pilot-Operated Back Pressure Regulators is based on their performance and reliability. They are maintaining constant back pressures within exceptionally close limits in all manner of services in the oil industry. You will find Neilan 47's in increasing numbers in gasoline plants and refineries. Holding steady back pressures on dry gas from absorbers, on stabilizer and still reflux accumulators . . . and batteries of them performing isolated service on high pressure traps at Kettleman Hills and other high pressure fields.

This star of the Neilan Line embodies frictionless ball-bearing construction, flexible multiple springs, Nirosta KA2 stainless steel valve stems and stuffing boxes, and the quality of being quickly and economically converted to any pressure range or even into a reducing regulator. All No. 47 Regulators are made with the Improved Neilan Seatringuide Valve, which greatly reduces flow turbulence and wire drawing. Furthermore, these regulators are compact and completely enclosed so as to prevent unauthorized tampering.

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Practical Analysis of . . .

LUBRICATING GREASES

By S. J. CAPLAN, Consulting Engineer

FOR the purpose of analysis, lubricating greases may be divided into two classes: (1) Those made from pitches and mineral oils, without soap; (2) those made from soaps and mineral oils. Actual analysis of lubricating greases made from combinations of pitches with mineral oils and perhaps fats and fillers is extremely difficult. It is easier to make duplications of greases of this type by trial than by attempting to analyze them. The duplication of such greases presupposes considerable familiarity with the vast number of pitches having commercial utility. For the present no effort will be made to outline a method of analyzing these pitch greases.

The class of lubricating greases made from soaps and mineral oils comprises the most important commercial lubricants. The following method of analysis is sufficiently accurate for the duplication of the greases. This method is applicable in the case of cup greases, fibre or sponge greases, mine car greases, ball bearing greases, block greases, cement mill greases, locomotive journal greases, hard tallow compounds and transmission greases.

The only extra equipment required is a centrifugal machine, which should be capable of rotating four cups weighing approximately 500 grams each at 1000 r. p. m. The cups should preferably be made from aluminum and should weigh approximately the same (to within one-fourth gram). They should have a capacity of 400 c.c. and be about eight inches tall. Each cup must be covered with a snugly fitting cap and the tare weight of each cup and its cap should not vary more than one-fourth gram from the other cups with their caps.

With this centrifugal machine two samples can be run at the same time in duplicate.

Before starting an analysis of this kind it would be well to have on hand a few gallons of specially distilled naphtha having a boiling range no higher than 210 degrees F.

Weigh up 100 grams of grease into each of two cups. (This analysis is being run in duplicate.) Add a small amount of special naphtha to each of the samples and work it thoroughly into the grease. Now add a little more of the naphtha and again stir thoroughly. When the grease has been thinned down in this manner until it flows readily, pour enough naphtha into the cups to fill them about three-fourths full. Balance cups and covers by adding naphtha. It is important to balance the cups carefully. If this is not done, the centrifugal machine will not rotate properly. Make certain that covers are placed on cups.

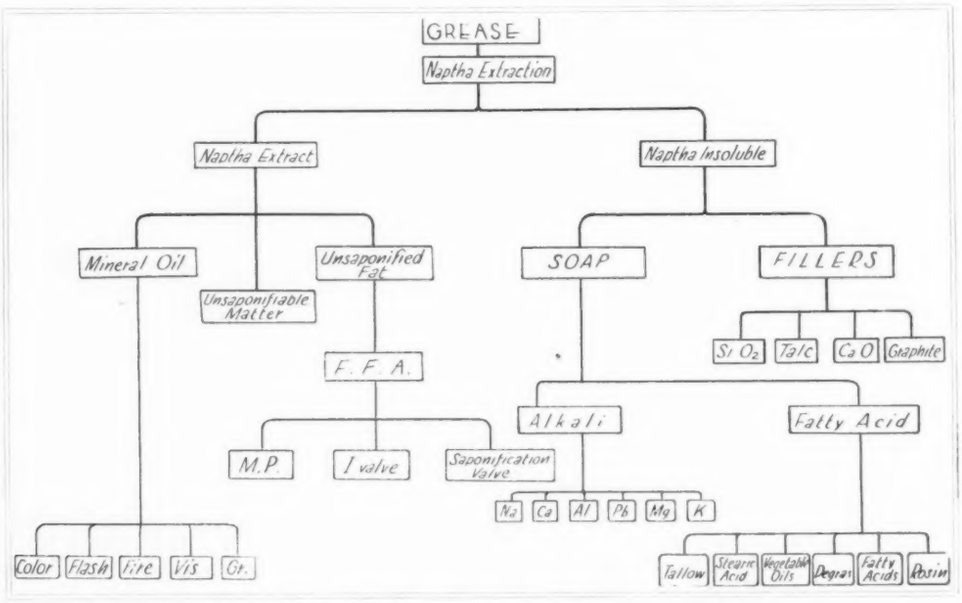
Now spin the cups at approximately 800 r. p. m. for one-half to one hour, or until the soap adheres firmly to the bottom of the cups and the supernatant liquid is clear and transparent. Transfer the naphtha extracts to large weighed distilling flasks.

Work a little naphtha thoroughly into the soap at the bottom of the cup. Add more naphtha and again stir thoroughly. When the mixture is thin enough to flow easily, add sufficient naphtha to fill cup three-fourths full. Balance cups (with covers) by adding naphtha. Cover and spin for one-half to one hour. When soap has separated entirely, the naphtha extracts are added to the first extracts that were placed in distilling flasks.

This extraction is repeated for a third time and the naphtha extracts added to the two previous extracts.

Naphtha Soluble Extract

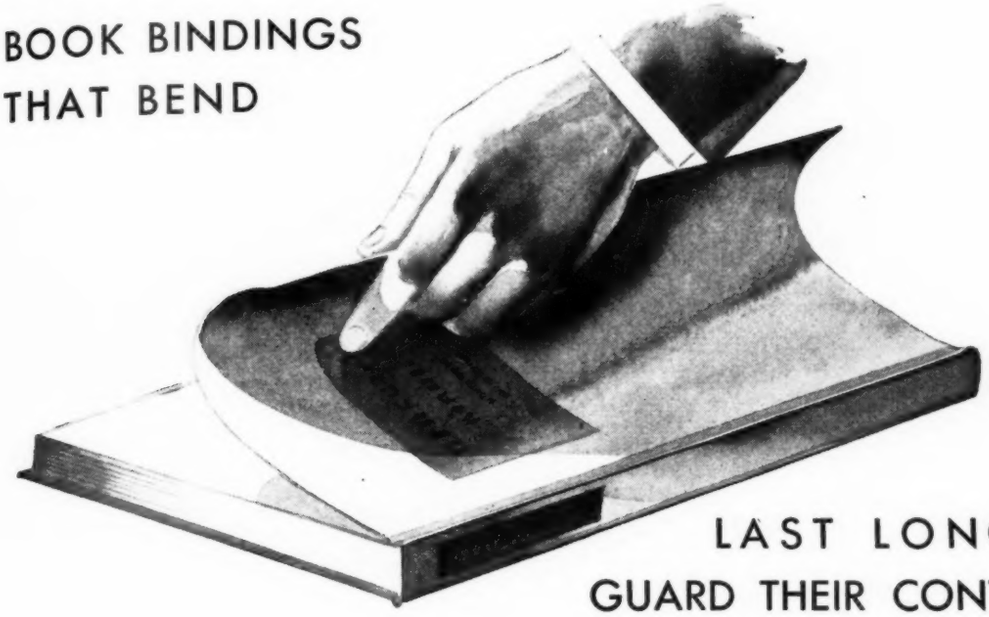
Distill naphtha from mineral oil. When most of it is over, disconnect the distilling apparatus, remove heat and place glass tube (which reaches to bottom of flask) into the distilling flask and blow inert gas through the hot residue until no more vapors are given off. Now place distilling flask in an oven heated to 212 degrees F. and take



Analysis chart.

FLEXIBLE THINGS ENDURE

BOOK BINDINGS
THAT BEND



LAST LONGER AND
GUARD THEIR CONTENTS WELL

FLEXIBLE CUPS ON THE GUIBERSON SWAB ARE SLOW WEARING AND LIFT ALL THE FLUID

A striking parallel may be drawn between the treasured contents of a rare volume and the valuable contents of a Guiberson Swab cup, lifting oil to the surface. The book is handled and tossed about by generations of readers, protected by its supple, bending cover. The swab cup passes through worn casing, over dents and protrusions, not losing a drop of the precious fluid and standing off wear for trip after trip into the well. Guide wires steer the cup rims over the damaged areas. The heavier the column of fluid, the closer the cup rims press against the casing walls, sealing up the load. The cup rubber is a special, non-deteriorating composition, good for many weeks in high gravity oil. Pressure from below collapses the cups, allowing far speedier passage into the well. The Guiberson Swab is doing most of the world's swabbing today.

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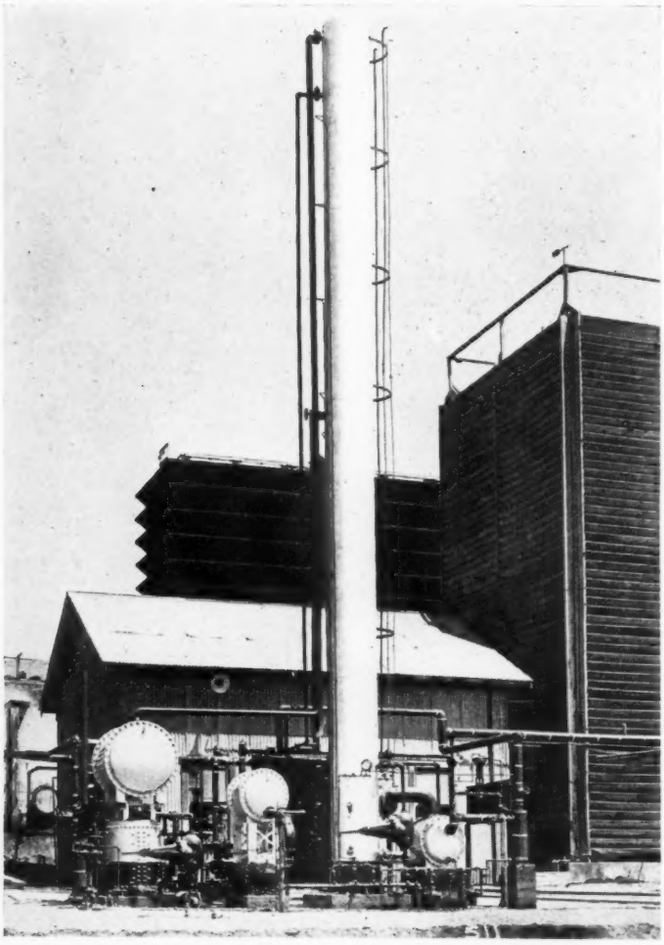


Distillation unit in an Eastern natural gasoline plant.

down to constant weight. The net weight of this residue in grams represents the percentage of mineral oil, unsaponified fat and unsaponifiable matter in the lubricant.

Run a saponification test on this mineral oil. If it contains more than one-half of one per cent of unsaponified fat (calculated as oleic acid), this fat can be taken from the mineral oil by boiling with an excess alcoholic potash. After washing the fat-free mineral oil with water and then drying at 212 degrees F., the mineral oil can easily be examined for (a) color, (b) flash, (c) fire, (d) viscosity, and (d) gravity. These constants are usually sufficient for identifying the mineral oil. If the naphtha extract contained no unsaponified fat or at most one-half of one per cent, it is not necessary to remove this unsaponified fat from the mineral oil before testing. While it is true that small amounts of impurities in an oil will change the constants of the oil, still the results obtained will be accurate enough in most cases.

If it is necessary to identify the unsaponified matter separated from the mineral oil, this can be done by acidifying the soap solution, washing the liberated fatty acids and testing for melting point. If necessary, a saponification value and iodine number may be run.

Naphtha Insoluble Extract

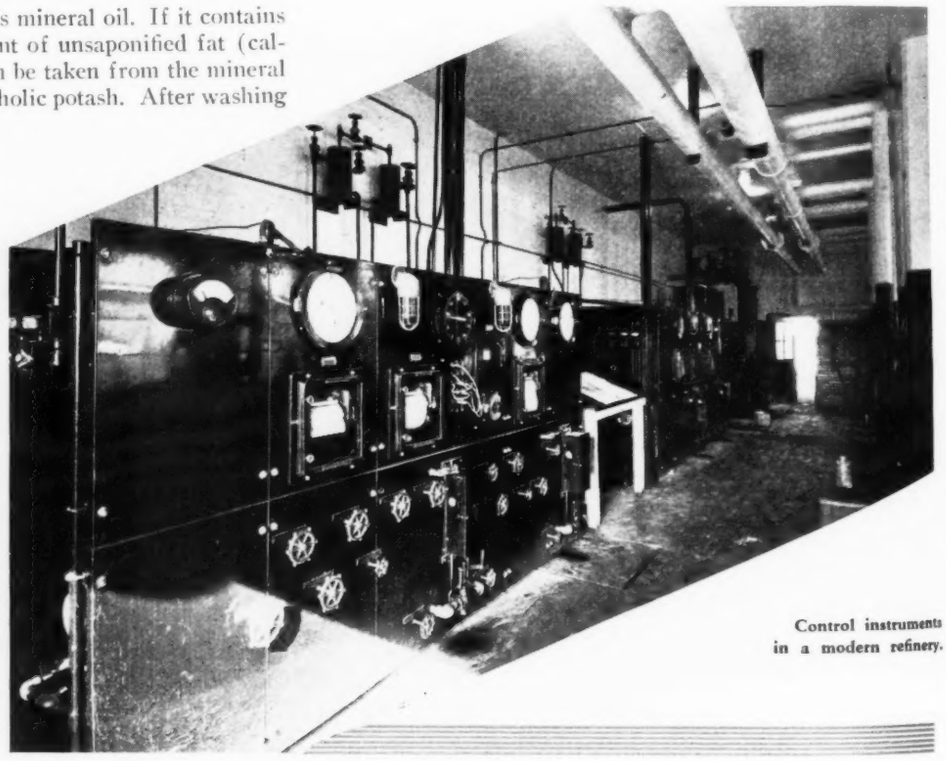
Place the cup containing the soap in an oven heated to 212 degrees F. and take down to constant weight. The weight of the naphtha insoluble residue in grams gives the sum of (a) soap, (b) filler and (c) glycerine. The sum of the weight of naphtha extract plus naphtha insoluble, when subtracted from 100 grams, gives the weight of water in the 100-gram sample.

It is always advisable to run an independent test on water. This can readily be done by weighing up a suitable amount of grease and distilling off the water with the Dean-Stark distillation apparatus.

A small portion of the dried soap is ashed. This indicates at once whether the grease is loaded and also tells whether the soap was made from Ca, Mg, Na, K, Pb, or some other metal. If the soap is made from NaOH (which is readily determined by working a small portion on the palm of the hand with water), the amount of Na_2O is readily determined by acidifying a weighed portion of the soap with an excess of acid, then titrating back the excess acid with

$$\frac{N}{2} \text{ NaOH.}$$

A sensible amount of soap is now boiled up with excess acid and the clear washed fatty acids dried to constant weight at 212 degrees F. and the following constants ascertained: (a) specific gravity, (b) solidifying point, (c) saponification value, (d) iodine value. With the aid of a book on fats and oils, the constituents of the fatty acids can usually be determined. If the fatty acids are composed of a complex mixture of different fats, it is extremely difficult to determine the individual fats that were used. In a case like this it is often quite helpful to rub vigorously a small amount of the fatty acids on the palm of the hand and note carefully the odors evolved.



Control instruments in a modern refinery.

Accurate Methods *Available for* Testing Welds

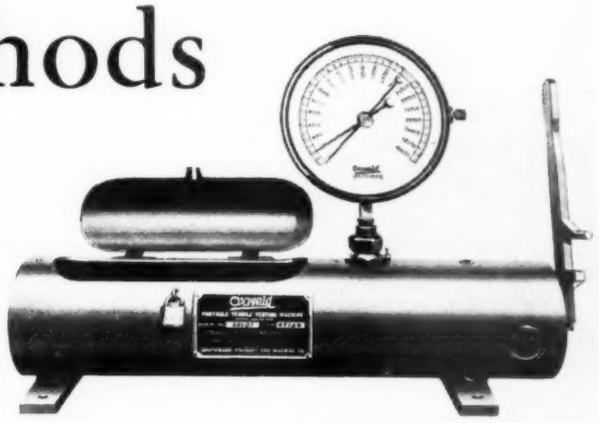


Fig. 2—Portable tensile testing machine.

USERS of oxy-acetylene welding no longer ask, "Can welds be tested?" As a result of scientific research in this field, their question today is, "Which of several accurate tests shall we use?"

The answer depends upon the reason for the test and upon the nature of the product to be tested. It may be desired to qualify a group of welders for an important project or to establish a method that can be used for routine testing of finished products.

There are almost a dozen testing methods available, ranging from simple hammering to tensile testing and including stethoscope tests, bending tests, hydraulic and air pressure tests, impact tests, stress distribution tests, X-ray tests, electrical and magnetic tests, and even the non-scientific but exceedingly interesting accidental tests. It is the purpose of this article to describe the methods and functions of each.

Stethoscopic Tests

Perhaps the least complicated is the stethoscope test which requires only a pein hammer, a human ear for listening and a stethoscope similar to the one used by doctors. The test is based upon the well-known fact that solid metal struck with a hammer sets up sound vibrations differing from those resulting from cracked or defective metal. The operation consists merely in striking the weld with the hammer and listening with the stethoscope at a point directly opposite the point of impact (see Fig. 1). Any defective spot is easily detected by the easily recognizable tone it emits. Several persons performing this test on a series of welds will be in agreement as to the location of defective spots. This method tells whether the weld is sound, but does not, of course, indicate the strength of the weld. To ascertain this, tensile testing machines are available.

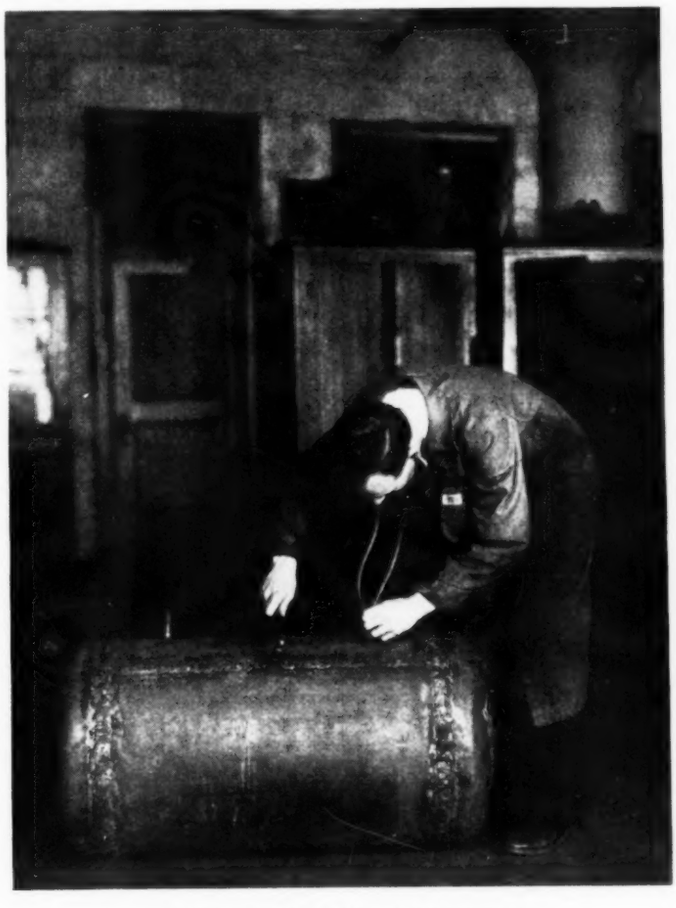


Fig. 1—Testing welds with stethoscope.

Tensile Testing Machine

For field use, the portable tensile testing machine offers the simplest and quickest way of determining the actual strength of a weld. Formerly, tests with this could be made only by sending sample welds or coupons cut from the weld to a testing laboratory where large, stationary tensile testing machines were available. Now, however, these tests can be made on the job with a rugged, portable machine such as shown in Fig. 2.

The machine weighs only 150 pounds, is 28 inches in over-all length and 6½ inches in diameter. It consists of a tubular compression member with a fixed set of grips in the head and a hydraulic cylinder block in its base. The cylinder block contains a communicating pump and cylinder directly machined into a single block. Cylinder pressure developed by means of a detachable pump handle operates a piston carrying a second set of grips.

The specimen to be tested is placed between the two sets of grips. After closing the release valve, a few strokes of the pump handle increases the load until the specimen breaks. The maximum load hand on the gauge indicates the breaking load of the specimen. The pressure is then released by a valve and the system returned to its original position by using the pump handle as a lever.

The machine is a self-contained, totally enclosed unit that can be shipped in its own case, with the pump handle detached and locked inside the door. the dial is shipped in a separate case.

A set of conical blocks may also be used in place of the grips, so that standard ½-inch diameter round specimens may be tested. Tests conducted with this machine under

widely varying conditions have shown it to be remarkably accurate.

The machine has proved to be especially useful in a number of industries because it enables the accurate determination of tensile strength of welds, without loss of time. This is particularly important in qualifying welders.

For testing completed welds in pipe, specimens cut from the pipe may be given tensile tests by means of the portable machine. There is also another type of machine which has been developed to provide a ready means of determining the quality of pipe welds by cutting a narrow specimen across the weld. The opening thus made can be rewelded.

Slot-Cutting Machine

To obtain such coupons from pipe welds, a portable keyway slotting machine has been devised. It is in reality a small milling machine. After selecting a weld to be tested, the inspector places the machine on the pipe at any reasonable angle, from 45 degrees on either side to the upright position. Two men then operate the handles which, through gears, transmit the power to the milling cutters. When the cut has been made, a small drill, cold chisel or cutting blowpipe can be used to cut the ends of the specimen for removal. Then the specimen, stamped with the welder's number for identification, can be examined visually as follows:

Visual Test of Specimen

Rub the specimen on a file held flat in a vise or backed up on a flat surface. This will give it a flat finish on one side. (Rubbing a file over the specimen will not.) Then rub it lightly on fine emery paper, etch in a 10 per cent solution of ammonium persulphate and examine carefully. The soundness of the weld metal and quality of workmanship will be clearly discernible.

Bend Tests

Equally as important as knowledge of the weld's maximum strength is knowledge of its ductility. This information can be obtained by means of simple bend tests of various kinds.

These tests require no expensive equipment and can be performed anywhere. All that is needed is a machinist's hammer, a vise and a flexible metal scale graduated preferably in hundredths of an inch. Test specimens can be cut from regular welds or prepared by welding two pieces of steel plate, usually ⅜ inch thick, with a single V-weld, and cutting it into coupons 1 inch or 1½ inches wide by 5 inches or 6 inches long.

These test coupons are first prepared by grinding down the weld, if it has been reinforced, then laying off the weld and adjoining metal very carefully, using center punch marks. These may be spaced ¼ inch apart, as shown in Fig. 3.

The sample is next placed in an ordinary machinist's vise, the jaws of which should come about 1 inch from the punch mark, and is struck with a hammer and bent over at an angle of about 10 degrees. The coupon is then reversed and the opposite end bent in the same direction. Bending in the vise, as shown in Fig. 4 follows. This allows the bend to occur freely, which is essential for accurate and consistent results. In case the vise does not expand enough to take the coupon endwise in its jaws, the coupon can be placed between the two jaw shanks to start. If the coupon does not start to bend immediately, a good plan is to exert additional pressure by means of a length of pipe slipped over the vise handle to give extra leverage.

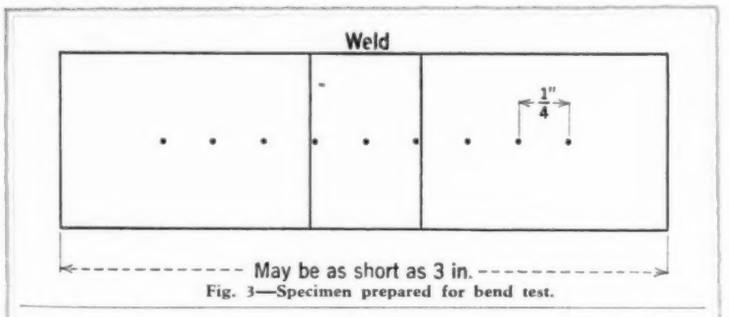


Fig. 3—Specimen prepared for bend test.

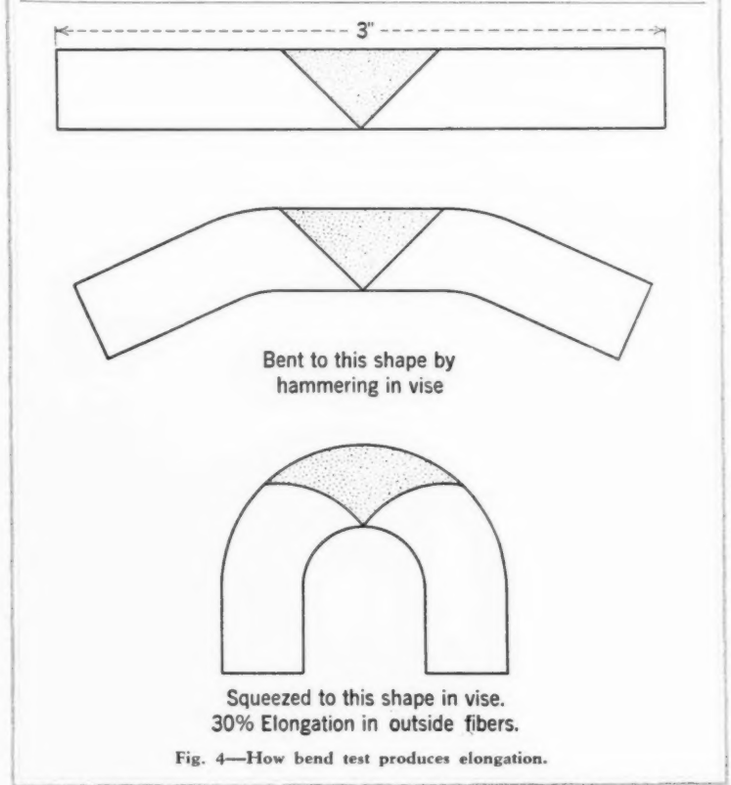


Fig. 4—How bend test produces elongation.

As soon as the first crack in the weld metal is observed, the bending is stopped and the distance between the punch marks measured with a flexible steel scale reading to hundredths of an inch. When the original distance between the marks is 1 inch, the per cent of elongation is identical with the number of hundredths of an inch in excess of 1 inch in the final measurement. Thus, if the first measurement between the points was 1 inch, and the final measurement 1.17 inches, the elongation would be 0.17 inch or 17 per cent.

Careful measuring of the elongation by this method will show exactly the amount of ductility in the weld metal. Cracks should appear first in the weld metal of a specimen in which the base metal and the weld metal have been properly fused and the coupons correctly prepared for the bending test as in Fig. 4.

Impact Tests

Resistance to impact or shock is a valuable property for certain applications, such as the weld made in double-length pipe which is subjected to considerable handling before it reaches the line. The standard Izod impact test consists of fracturing the projecting end of a notched specimen by striking with a swinging pendulum. This produces fracture with one blow under cantilever action. The energy in foot pounds absorbed in producing fractures is taken as a measure of the resistance of the metal to fracture when

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subjected to shock. Fig. 5 shows the details of this test and is self-explanatory.

Pipe Bend Test

Another bend test to determine the ductility of several yards of pipe and its welded joint was performed by a company laying a submarine oil loading line on the Pacific Coast.

Two timbers were placed about two feet from the joint. These held the pipe so that when the deflection test was made the strain would be thrown on the joint. The pipe was deflected five feet, deflection occurring about four inches each side of the collar. The joint was subjected to about 9,000 pounds actual cantilever load, or 185,900 pounds moment at the collar, and about 60,000 pounds longitudinal strain. During the test, the pipe was subjected to 750 pounds water pressure. While it was under the greatest strain the joint was struck three blows with an 8-pound sledge hammer, Fig. 6. No leak developed and at no time did the joint show signs of weakening.

Pipe was then cut out about 18 inches each side of the collar and the section placed in a milling machine and cut into strips about 3 inches wide. At no place on the strips did the weld show effects of the strain. In all cases there was perfect fusion of pipe and weld metal.

Although this test is more severe than is ordinarily required, it does furnish a combination of strains which closely duplicate those imposed by the most severe service conditions.

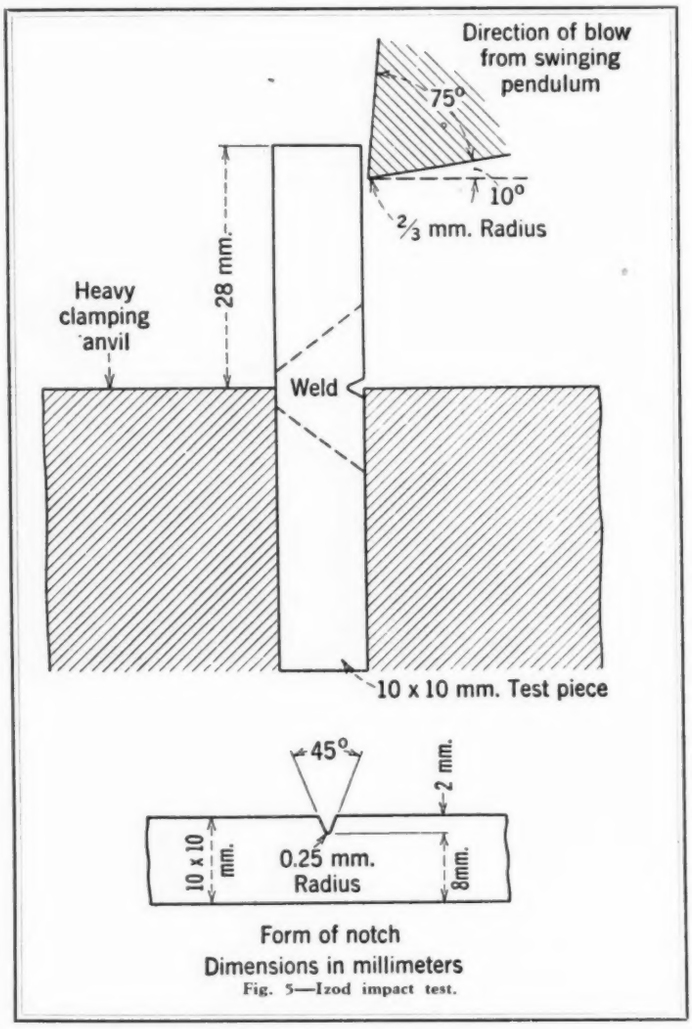

Fig. 5—Izod impact test.

Hydrostatic Pressure Tests

For testing pressure vessels or pipe joints in which absolute tightness is essential, application of hydrostatic pressure affords a convenient means of determining the soundness of welds, because:

(1) The pump need not be large, since water can be compressed only slightly. (2) High pressure can be obtained more easily this way than in any other. (3) In case of sudden release of pressure there is little tendency for the parts to be thrown about violently.

The equipment necessary for making hydrostatic tests consists of a small pump, a pressure gauge and some piping connections. Suitable pumps for this purpose are made small enough so that they can be easily carried and are quite moderately priced. Such pumps are used by boiler inspectors in their routine work of testing. The pump illustrated in Fig. 7, or even a smaller type, is suitable for ordinary shop or field work since pressures up to 6,000 pounds per square inch are easily obtained.

In applying the test to pressure vessels and other closed containers, all lower openings and outlets are first closed and the vessel completely filled with water, making certain that no air pockets are left. Upper outlets are then closed. After connecting the pressure line to the tank or pipe, the pump is operated until the gauge shows the desired pressure. This is usually at least 1½ times the normal working pressure.

In the case of pressure vessels, procedure control specifications call for a hammer test while the vessel is under hydrostatic pressure of twice the designed working pressure. The weight of the hammer in pounds is equal to the shell thickness in tenths of an inch, and the blows must be struck at 6-inch intervals on both sides of the weld for the full length of the seam. Each seam is then given a thorough visual inspection. Following the hammer test, the hydrostatic pressure is raised to three times the designed working pressure and the seams again inspected. This pressure-impact method is used as a means of testing the strength and soundness of welds for high pressure service.

Air Pressure Test

In the case of pipe lines for oil and gas, it is frequently difficult to obtain large volumes of water necessary to fill long sections of lines under test. In addition, there is the difficulty of draining off or pumping out the water after the test is completed. It is customary in such cases to test pipe lines with air pressure because it is more convenient to use.

After blanking off the section of line by means of a bull plug, or other suitable closure, Fig. 8, and attaching pressure gauges, compressors are placed in operation until the test pressure is built up in the line. Each weld is then painted with soapy water and carefully inspected for bubbles, which indicate pin-hole leaks. Test specifications may also require that each weld be hammered vigorously while under pressure and then tested again with soapy water.

In addition, gas lines are frequently required to hold the test pressure over a period of 24 hours or more, recording pressure gauges being attached to the line to register change in pressure. In the results, allowances must be made for temperature fluctuations.

Reheating Test

A non-destructive test, capable of application to light gauge sheet metal products which cannot be subjected to pressure tests, is used by a manufacturer of high-grade automobiles. Using an oxy-acetylene welding blowpipe with a fairly large head, the inspector heats the entire length of

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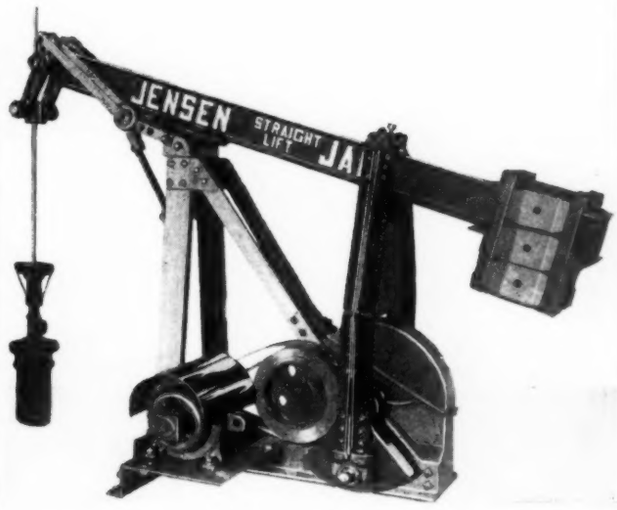

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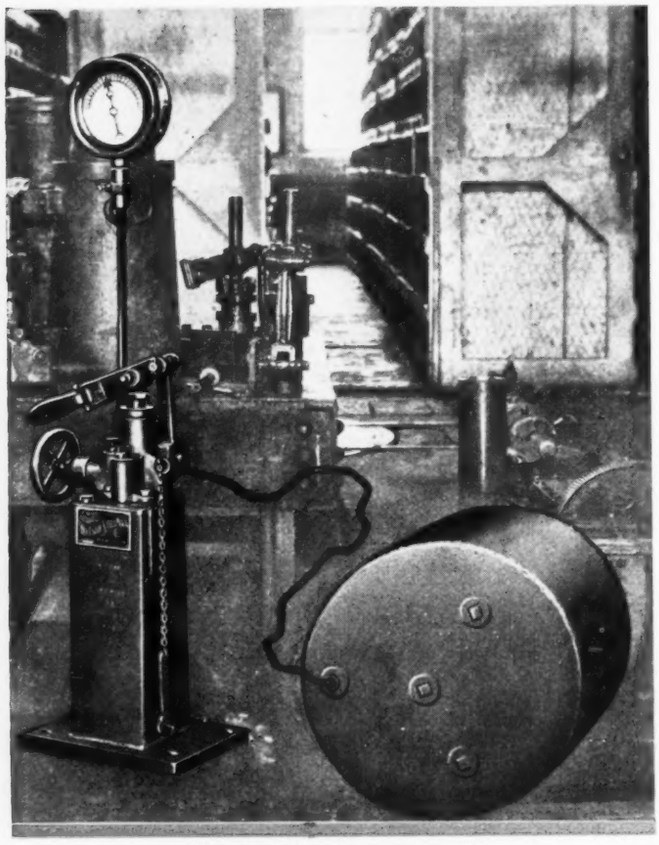

Fig. 6—Hydraulic pressure pump.

the seam gradually and evenly to a medium red. As the weld is thicker than the adjacent sheet metal, it does not heat up as rapidly as the sheet. A perfect weld will show a uniform, unbroken, darker stripe in the heated area. The presence of any defects in the weld due to incomplete penetration, blowholes, cold shuts or laps will be indicated by bright spots in the relatively darker weld area. Where thorough fusion has not been obtained between base metal and weld metal, these sections will also show up bright while the rest of the weld will remain dark. The inspector melts out any defective spots with the blowpipe and returns the piece to the operator for rewelding. Experience has shown this method to be rapid, accurate, and economical.

Stress Distribution Tests

When it is desired to know the stress distribution in welded joints, it can be determined by the use of strain gauges, devices for measuring accurately the very slight movement that takes place in a given section of a structure when load is applied. There are three general types:

Hand Gauges: These are operated by inserting the sharp steel pins of the gauge into two small holes drilled in the structure, then reading the amount of movement under loading on a dial calibrated in ten-thousandths of an inch.

Huggenberger Tensometer Gauges: These are similar to hand gauges except that they can be attached to the structure by small electromagnets. A lever multiplies the movement and expresses it on a dial calibrated in hundred-thousandths of an inch.

Electric Telemeter Gauges: These are electric strain gauges. Movement between the gauge points unbalances a Wheatstone bridge circuit, the amount of unbalance being registered on a millivoltmeter. Several of these gauges may be fastened at various points of a structure and the wires brought to a point where readings for each may be taken in turn.

Of the three, the electric telemeter is easiest to use.

Other Tests

The foregoing outline of tests includes practically all that are applicable to field use. There are, however, several others which, while scientifically sound, are suitable chiefly for laboratory use.

X-Ray

One of these is the X-ray test. This reveals to the eye what the stethoscope reveals to the ear. Because the X-ray penetrates bodies whose densities render them impervious to ordinary light, it is possible to register on a photographic plate a picture of the interior of the joint showing all flaws or gas pockets exactly where they occur. With this method, it is possible to estimate the actual strength of the weld to within 3,000 pounds per square inch.

Electrical and Magnetic

The procedure in electrical and magnetic tests is to measure the electrical or magnetic potential drop across the weld, with a definite electromotive force or magnetic potential applied on opposite sides of the weld, and fairly close to it in order to localize the effect. This drop is compared with the drop over an equal length of unwelded metal. If both the conductivity and the known tensile strength of the unwelded metal are represented as 100 per cent, the tensile strength of the welded metal can be computed from the potential drop.

Of the two, the electrical test gives figures more nearly approaching those obtained with the tensile test machine.

Accidental Tests

Accidental tests of welds, while not scientific and certainly not subject to control, demonstrate more convincingly than any other whether the welding is good or bad.

Conclusion

From the foregoing, it is evident that the testing of welds not only is possible, but is as simple, as practicable, and as highly developed as testing methods for other metal fabricating processes. Combined with procedure control and inspection of operators at work, testing is the final step that eliminates guesswork and makes oxwelding a most dependable construction method.

Fig. 7—Sealing line before testing.

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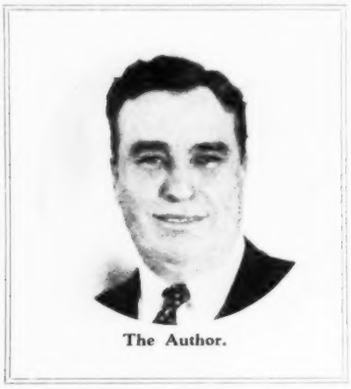
Suggestions for the Use of » » »

Portable Well-Pulling Equipment

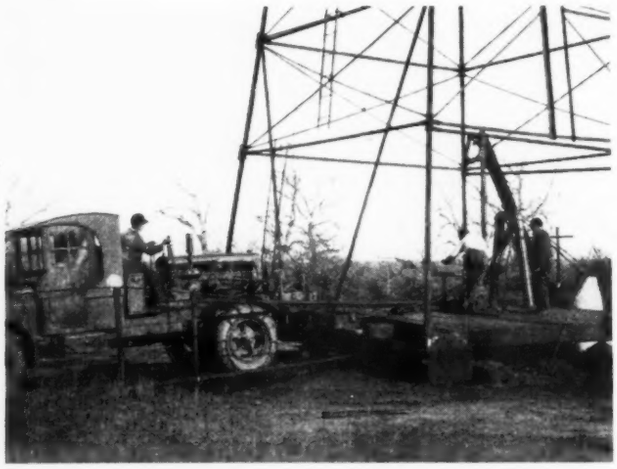
By FRED E. COOPER

THE use of portable well-pulling equipment is a matter deserving of thorough study. The winch tractor and the stationary winch mounted on a truck are the two units most commonly used for the purpose. The economy and adaptability of these in handling a large number of widely scattered wells have resulted in many oil companies standardizing on them for well-pulling operations.



The Author.

Selection of the kind of portable well-pul'ing equipment to be used is governed by conditions under which it has to work and the job it must perform. The winch tractor is naturally the most practical piece of equipment where wells are not too widely interspersed, and it is built to operate under exacting conditions. It also serves a wide variety of useful purposes around the lease, such as for moving boilers, skidding derricks, all kinds of heavy hauling, filling slush pits, grading roads, cutting ditches and general construction work. A good tractor is one of the most beneficial items of equipment that can be put on a lease.



Construction of Winch Tractor

Construction of the machine is simple. A winch is easily made and mounted on a tractor, truck or movable conveyance. The first thing to take into consideration, however, is the balance of the machine, since the tractor is frequently moved from one location to another, and if not properly balanced, is decidedly troublesome.

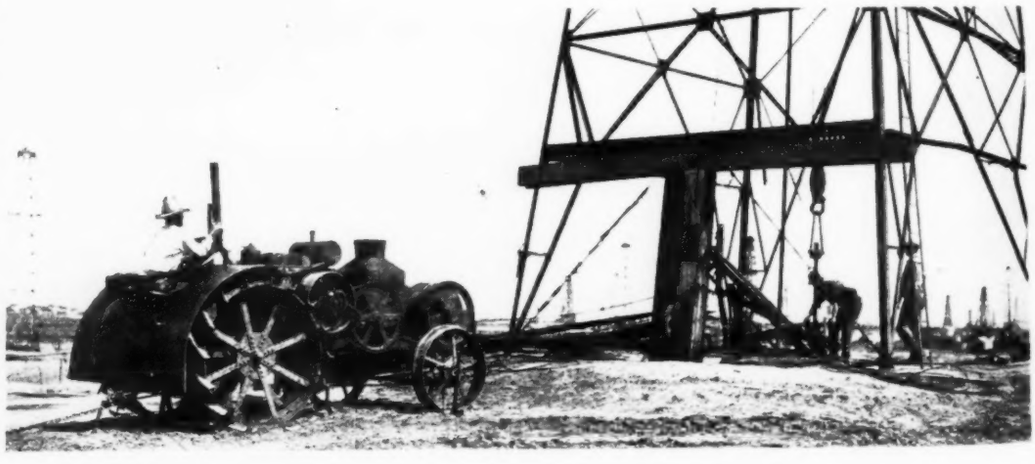
If the machine is built too high off the ground, it will naturally be topheavy and have a tendency to turn over when working in rocky and rough country. Almost invariably this will happen when it is necessary to winch out of a mud-hole, sand bed or over a rocky hill—an operation which sometimes must be performed with any kind of portable pulling equipment.

The front wheels will cut into soft ground more deeply than the rear wheels if excessive weight is put on them, due to the fact that they are smaller. If the front wheels cut in, the load on them is increased in direct proportion to the power required to push them. Thus, they cut in deeper than if they were merely carrying the weight of the machine.

The traction of the machine is also reduced by having a preponderance of weight on the front wheels, since the machine does not have sufficient traction to push the front wheels and move the load over soft ground properly without the rear drive-wheels spinning. The ideal condition is to balance the machine so as to carry as much of the weight as possible on the rear or drive wheels, in order to hold the traction.

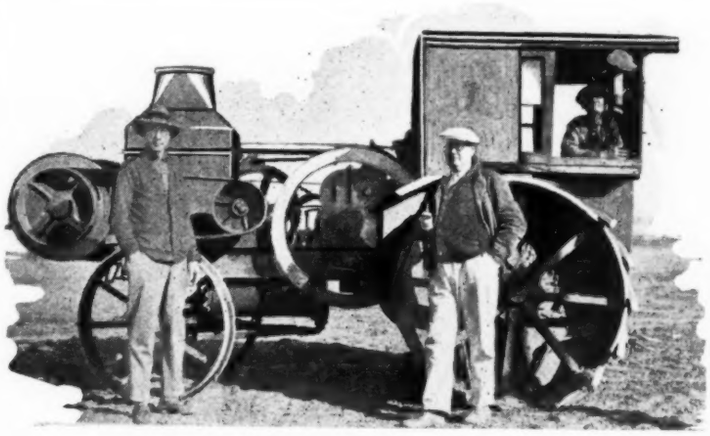
However, it is not desirable to place too much of the weight on the drive-wheels, as, in that case, the tractor would have a tendency to rear up in front on steep hills or on a hard draw-bar pull. Then, too, if the weight is extended too far back, the winch drum or any other part

(Above): Pure Oil Company crew pulling a well in the Drumright, Okla., pool. (Right): Winch Tractor of Comar Oil Company pulling rods at Tonkawa, Okla.



of the machine protruding too far rearward will strike against the ground in going over ditches and bad places, thus losing traction and endangering the mechanism. With a machine having the load extending back of the rear wheels, it is necessary (for the convenience of the operator handling the machine and for the balance of the tractor) to have this weight low. Consequently, it is extremely difficult to avoid the troubles mentioned.

The safety of the operator must also be considered in the construction of a well-pulling unit. Much money has been spent by the oil companies in the interest of safety. They guard against placing a man directly over a winch drum built on the rear of a tractor, as he would have slight chance of protecting himself should the line break or hurl slack.



The oldest winch tractor in the Mid-Continent. It now belongs to The Empire Company and is in use in the Covington field. It is 8 or 9 years old.

As to the size of the winch drum, it is as easy to build one two or three feet in diameter as two or three inches. The size of the machine should first be calculated as well as the weight for proper balance, the depth of the wells, and the size of the line required. Recommendations can be obtained from wire line manufacturers as to the most suitable drum size for the size lines required. The winch drum should be built in proportion to the depth of the wells the machine is expected to handle and according to the diameter of the drums recommended by the wire line manufacturers.

Naturally, it is necessary to have the drum sufficiently large in diameter so that the line will not be kinked and wide enough so that sufficient line can be spooled for the different jobs. It is not practicable, however, to use a winch drum that is too wide as it has a tendency to pull the machine sidewise when the line spools to either end of the drum, rendering it impossible to keep the machine lined up so that the wire line will spool properly.

In pulling rods and tubing it is best not to have more than two laps of wire line on the drum at one time and there positively should be no more than three at any time. Too much line on the drum naturally increases the speed of line travel and cuts down the pull materially. It also makes the line "cut in" to such an extent that it is very difficult to run the tubing in the hole.

The drive mechanism should be built ruggedly and so that it will not get out of alignment and throw unnecessary side strains on the machine. It is easy to build many different kinds of drives for a winch drum, but it must be remembered that the chief function of the drive is to transmit power to the winch drum, making it revolve so that the line is spooled properly. All side strains and as much friction as possible should be avoided.

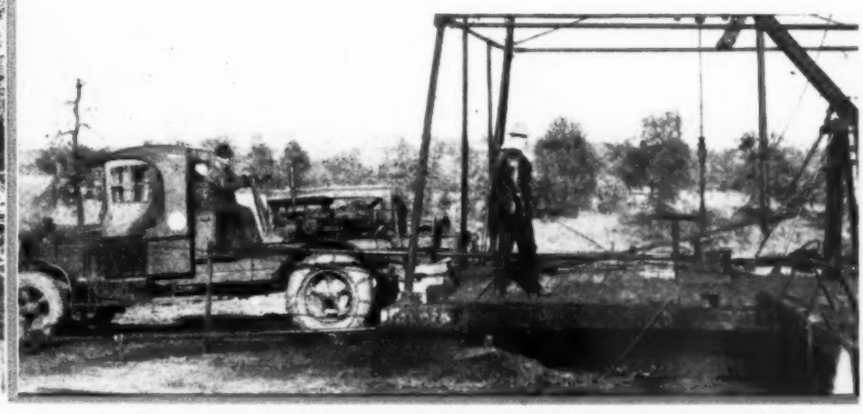
The operation of the machine should also be considered. The machine should be constructed so that the operator can, at all times, without changing his position, see at a glance the entire machine, the derrick, the men on the rig floor, even to the crow pulley. Otherwise, serious accidents to the men or property are likely to occur. If it is possible for the operator to hold the entire mechanism within his vision he can keep his machine in much better condition than otherwise.

For the greatest efficiency and service, a machine should have as few working parts as possible, and these should be built sufficiently strong to withstand the hardest use. Simplicity is the keynote of efficiency and when too many mechanical ideas and arrangements are used complications will develop, loss of power and other difficulties will be encountered, resulting ultimately in high repair cost.

It should be borne in mind that a tractor is not a truck or an automobile and cannot be expected to take the place of either. If the wells to be pulled are widely scattered a tractor cannot be constructed to handle such work economically.

High speed transmission, rubber tires and all sorts of road equipment can be put on a tractor, but it is still a tractor. If one tries to make a truck or an automobile out of

Pulling a well at Owensboro, Ky.



A truck unit in the Drumright field. Clyde Vinton, Pure Oil Company, supt., on rig floor.

it he invariably runs into serious trouble and high repair bills.

While considerable cost is involved in putting rubber tires on a tractor, they are worth the cost in the long run in many districts. They lengthen the life of the machine and save materially in up-keep and repair cost, due to the fact that they eliminate a great deal of road shock. However, rubber tires are not suitable for all conditions. If ground conditions are unfavorable special wheel equipment designed to meet these conditions should be used. It is not reasonable to expect the same wheel equipment to function equally well in the swamps and the Rocky Mountains. And one would not use the same wheel equipment in the snow banks of the north country that he would in the desert.

The truck unit is important as portable well-pulling equipment. If it is necessary to move the equipment a considerable distance, the crew, tools, etc., can be transported on the same truck and a good day's work accomplished.

There are several different ways for mounting a winch on a truck for pulling wells. One is to mount it on the truck frame and power it by the truck motor and mechanism. The objection to this method is that, in pulling the well, the load is too variable. One minute there is no load and the next a dead load, thus overtaxing the truck. The truck mechanism is not built and designed to stand that kind of service, and truck manufacturers do not recommend it. It is difficult to use power take-offs and auxiliary transmission without throwing side strains on the entire truck and frame, besides necessitating a long chain of gears and a loss of power.

If the winch or drum is built onto the truck frame or chassis it is usually necessary to do considerable welding and cutting on the truck frame, naturally weakening it. An arrangement of this character necessitates the center of the winch drum being placed from 18 inches to three feet above the line of the frame. When it is necessary or desirable to pull a load straight out behind or through a snatch block on the floor of the derrick, a tremendous strain is thrown on the truck frame, invariably causing trouble from broken frames. The winch drum should be as nearly on a line with the truck frame as possible in order to avoid this leverage.

When the winch is powered from the truck mechanism, it is usually necessary to place the winch near the center of the truck or as nearly over the truck transmission as possible to secure ease in conveying the power to the winch drum. This is inconvenient when it is desirable to back the machine into the derrick and pull over the crown pulley, as it is necessary to run the wire line away from the derrick.

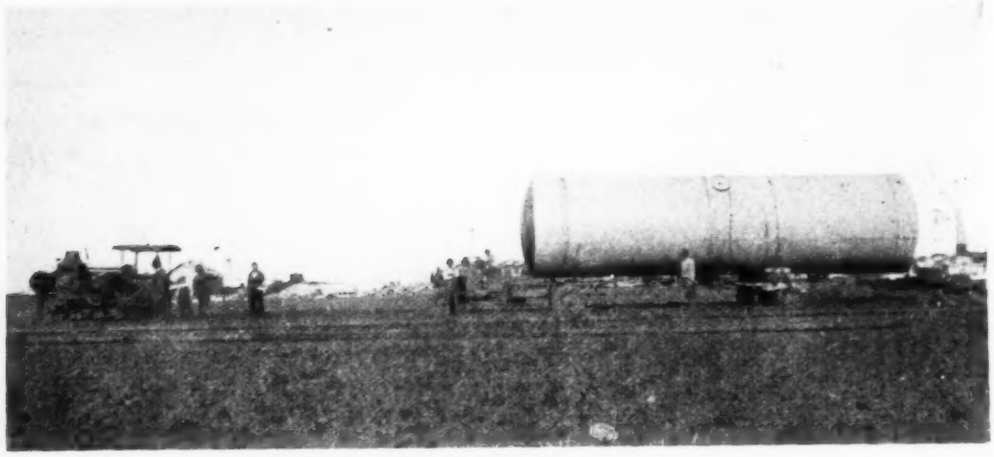
The most efficient truck-mounted winch for pulling wells is one built as a complete unit on a skid frame which may be mounted on the truck chassis. The unit has its own motor, transmission and winch drum relieving the truck of all duties except transporting the unit.

A unit of this kind will work efficiently whether setting on the ground, mounted on a platform or placed on the derrick floor. Many times this has an advantage. For instance, if the winch has to be used for a long bailing job or one requiring that it be tied up a week or more in one place, the winch can easily and quickly be removed from the truck, leaving the truck free for other uses.

There is little to be said about the many and varied duties to which a truck unit can be put, other than general hoisting work and pulling wells in scattered localities. A truck unit makes it possible and economical to pull wells within a radius of 25, 30 or 40 miles. For illustration, a short time ago, one company truck unit and crew drove 67 miles and pulled a 3,000 foot well and made the return trip in one day.

Bear in mind that the natural tendency is usually to go to extremes, and do not try to use a truck winch where a tractor is the more practical. Neither try to use a tractor where distance is a great factor.

A pulling crew of the Wilcox Oil & Gas Company as they prepare to leave a well after pulling rods in the Slick, Okla., area.



Tractor being used for heavy hauling in muddy field.

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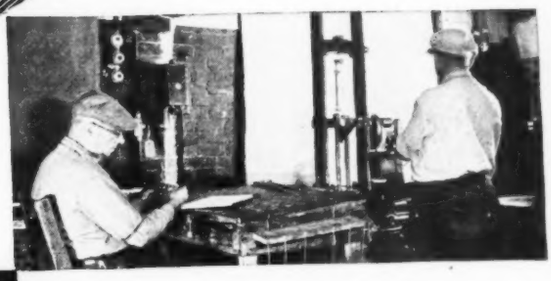

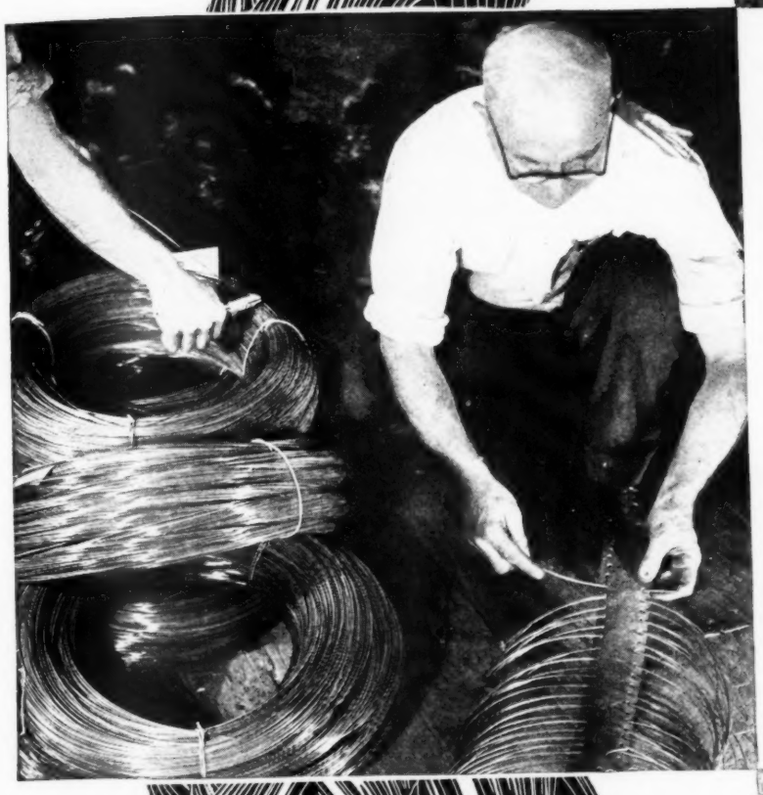

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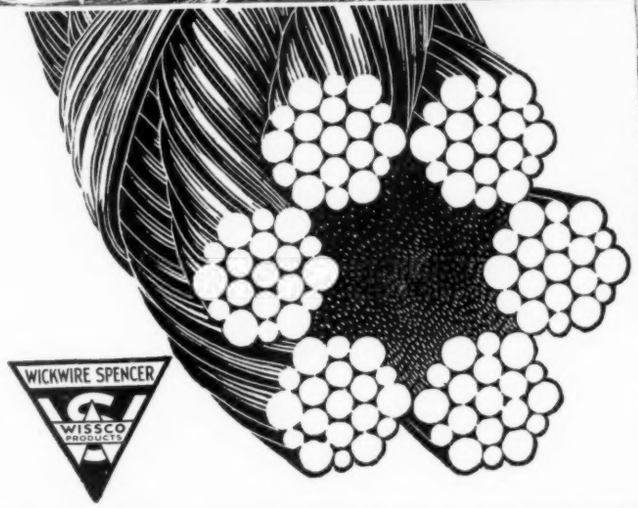

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New Welding Process Used

on California Pipe Line

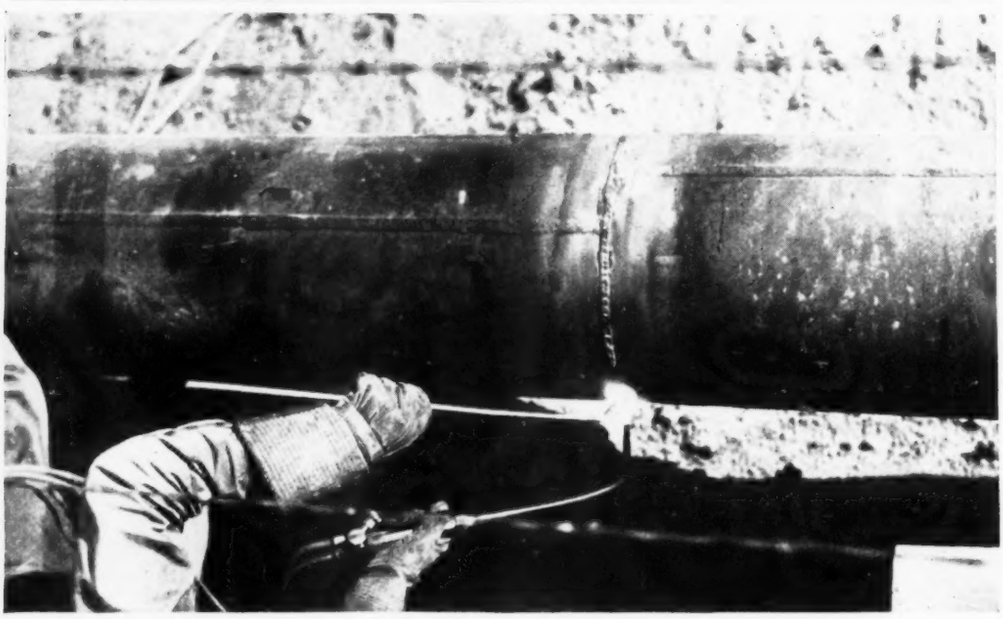
Above—In Toro Canyon, where the rock had to be blasted out for making the ditch. Below—Note the narrowness of the new type of weld which is just being completed at a bell hole.

By W. A. SAWDON, *Consulting Petroleum Engineer*

EVERY pipe line location in California seems to offer widely different conditions affecting its construction. While portions are often along highways and through level country and rolling hills, other sections have to be laid in rugged areas and buried in rocky soil. Welded lines are the vogue, especially for the transportation of gas; and the latest methods are generally employed on each new line. Many projects bring out the late developments and illustrate construction methods that can be used to advantage on other jobs. The line recently completed for the Southern Counties Gas Company from Santa Barbara to Ventura, California, is of particular interest. Not only were some difficult conditions encountered in its construction, but a new type of oxy-acetylene welded joint was also used for the first time in this section of the country.

The line is thirty-five miles in length. The southern half from Ventura north was built by the Lang Construction Company and the northern part to Santa Barbara by the Southern California Construction Company. This latter portion included about three miles of very rocky country, a section through the exclusive residential district of Montecito and a considerable portion along a highway which necessitated several underground crossings without interruption to travel.

The ditch work in the rocky section naturally slowed the operation down to some extent. The character of the ground can be seen in the accompanying photographs and its roughness prevented the use of a definitely organized crew for either welding and laying. The company had trained men, however, who adapted themselves to the unusual conditions. During a period of sixty days an average of 250 small shots of dynamite per day was necessary to prepare for ditching, and many bell holes had to be made in solid rock. The backfilling also offered difficulties and the line had to be primed with soft dirt for the entire stretch of three miles. In many instances this dirt had to be hauled in to cover the line since some parts of the location were absolutely devoid of any material but rock. The pipe used on this job was 16-inch O. D. in 40-foot lengths. In making crossings under highways, tunnels were drilled with a hole diameter of 18 inches. The longest one of these was about 70 feet in length. The pipe was shoved through these tunnels and, in order to protect the coating, ordinary house lathe was placed longitudinally around the circumference at approximately 2-inch intervals. These were thoroughly wired on and made a protective armor of a thickness that would allow the pipe to go through the tunnel with ease and yet have little or any clearance between it and the walls. The drilling of the



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tunnels was performed by a company which specializes in this kind of work.

A protective coating was applied throughout the entire length of the line. The pipe itself was delivered with a priming coat and no other primer was felt necessary. A coating was first brushed on and over this was placed a wrapper of asbestos paper. A hot application was then placed over the paper by means of a canvas sling.

The method of lowering the pipe into the ditch is shown in the photograph. In order to protect the coating, lugs were welded on to the made-up sections before any of the pipe covering was applied. These lugs consisted merely of a strip of metal in which was a hole for the insertion of a dowel or pin. This strip was set with one end welded to the pipe and the lugs were located at intervals of approximately 100 feet. After the pipe was lined up in the ditch, the pin was removed and the lugs left in place. In any method for lowering the pipe other than that shown in the illustration use can be made of such lugs to equally good advantage. Pipe handled in this manner will probably receive the minimum amount of injury to its coating and the expense entailed in making and welding on the lugs is almost negligible.

From 100- to 300-foot lengths were welded together before the pipe was lowered into the ditch. The character of the ground, the bends and other factors governed the number of joints and no established procedure could be followed. The final tie-ins were usually made in the early morning or after the line had been in the ground and backfilled for at least 24 hours. All temperature influences were thus eliminated.

Since an entirely new process of oxy-acetylene welding was used, the Southern California Construction Company first made a series of tests. It was originally believed that only rolling welds should be made, but stationary welds were found equally satisfactory. As the men became familiar with the method and experienced in the handling of the metal, the stationary welds were made as easily and quickly as the rolling welds.

A new type of oxy-acetylene weld was used on this line. Its main characteristics consist of a special adjustment of the flame plus a specified manipulation of the torch and the use of a particular welding rod. The weld is applied in one bead and one of the outstanding characteristics is that plain end pipe can be used without the aid of a liner or backing-up strip. The contractor claims that the deposited weld metal will penetrate through to the underside of the pipe without forming large icicles around the interior circumference at the joint. The design of the joint of the plain end pipe is of particular interest and is given in exaggerated form in Fig. 1.

Referring to the drawing, it will be seen that the bevel on the end of the pipe is at an angle of from 55 to 60 degrees, which makes a narrow welding surface on the outside circumference of the pipe. This, together with the overlap of 1/32-inch or less from the end of the pipe, insures a saving of welding metal. Only that portion of the inside edge is at right angles to the axis of the pipe as is absolutely necessary. The thickness of the weld reinforcement beyond the external surface of the pipe is kept at about 25 per cent of the pipe thickness. The edge of this extension beyond the outer circumference of the pipe is practically at

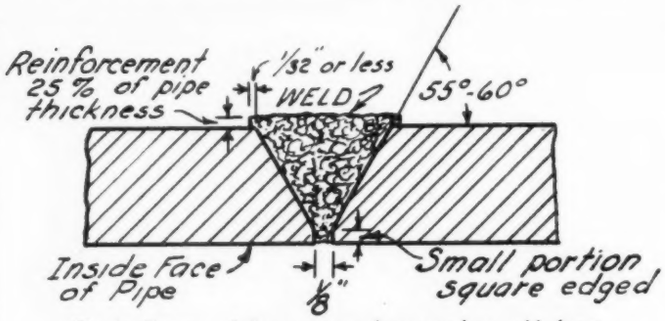
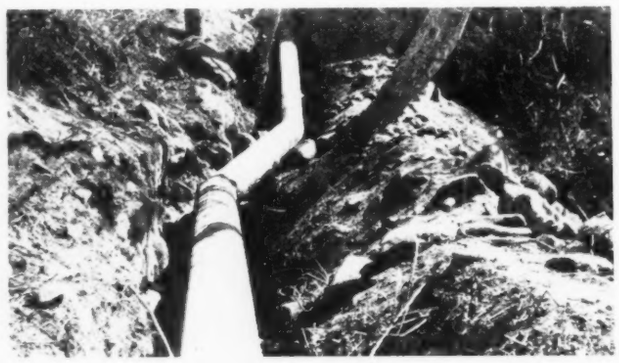
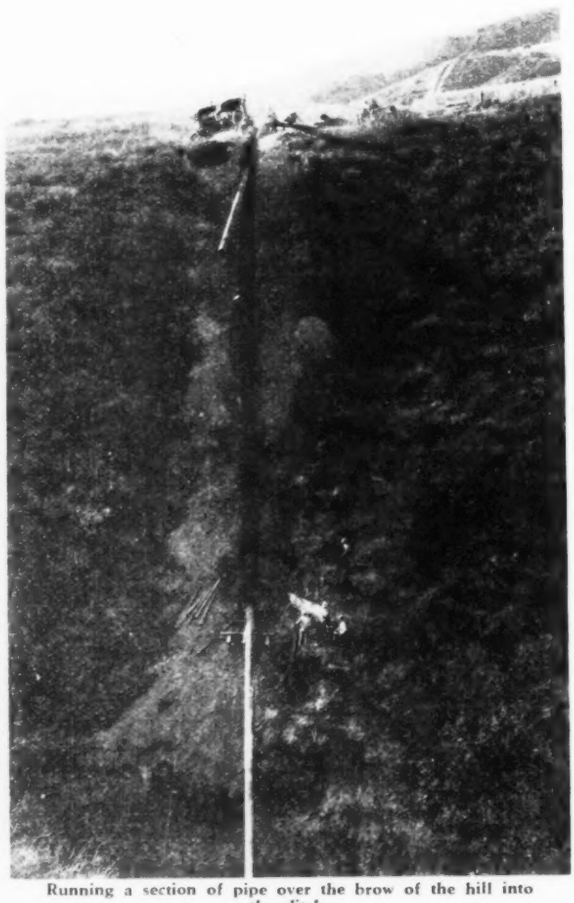


Fig. 1—Features of the new type of oxy-acetylene weld shown in exaggerated form.



Even trees added to the difficulties of laying the line. The two here shown in Toro Canyon had to be left in place and made necessary bends changing direction both horizontally and vertically.



Running a section of pipe over the brow of the hill into the ditch.

View of Foster Wheeler gasoline absorption plant which has a capacity of 100 million cu. ft. of gas per day. The nine absorbers with scrubbers are shown at the right. The fractionating units and stabilizer are to the left of the central aisle. The Foster Wheeler atmospheric type cooling tower and steam generating plant are located in the background.

Gasoline Absorption Plants

This gasoline absorption plant was designed and erected by Foster Wheeler. It includes two units, each having a capacity of 50 million cu. ft. of gas per day, stabilizers, a complete boiler plant, atmospheric type cooling tower and storage tanks.

The progressive design employed is exemplified by the use of internal coolers in the absorbers. These maintain moderate fat-oil temperatures which results in increased capacity of the oil to carry, and a lower rate of oil circulation. Provision is made for driving the turbines either by high pressure gas, steam or a combination of steam and high pressure gas.

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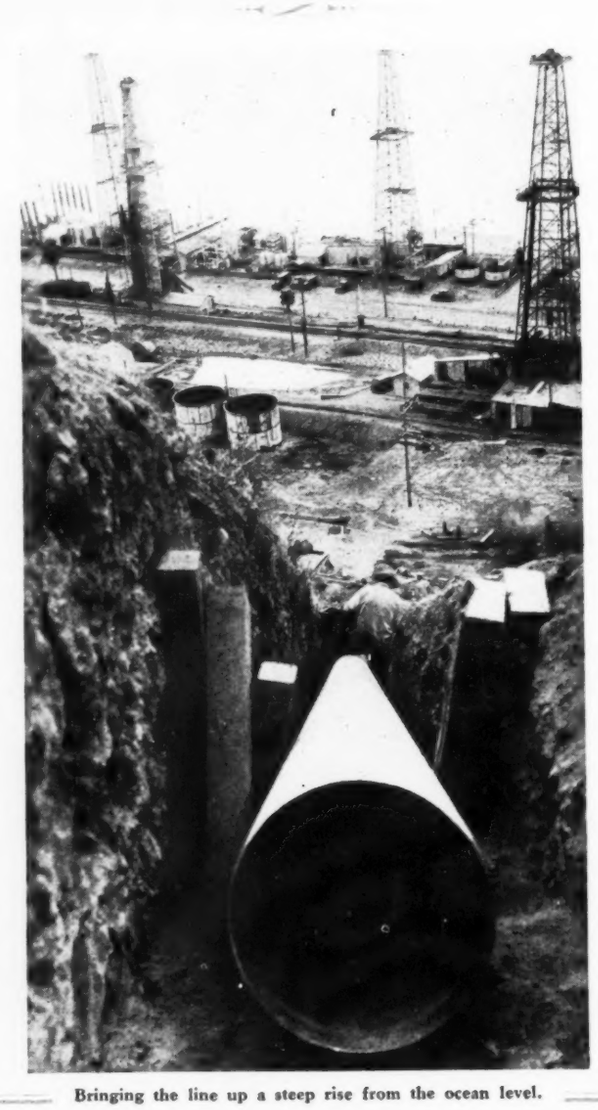
right angles to it. In large diameter pipe of from 18-inch up, various types of specially designed liners can be used to advantage. These, however, have no influence on the welding process and neither aid nor interfere with it. Another feature that will be observed in the drawing is the small distance that must be maintained between the ends of the pipe. As indicated, they are tacked at minimum depths of about ⅛ inch. In welding the pipe it was found that the ends did not creep together and that there was no visible lessening of the space between them upon the completion of the weld. This would indicate that the distortion which usually accompanies oxy-acetylene welding was eliminated. Such a feature is especially important on the large diameter pipe.

The training of welders for any new departure is always a matter of importance. The construction company found that the average welder could be trained to use this process properly in a few hours. After such a period he was able to make good welds when he was placed on the line. Although the work was done under the careful direction of an engineer, the process should not, of course, be used without proper attention and instruction. All projects which have used this type of weld to date have been under the supervision of engineers as far as the welding work was concerned. As mentioned above, it was first recommended for rolling welds only, but experience has shown that it is adaptable as a regular practice for overhead or stationary welds.

The economics of any new process is naturally of considerable importance. There are, however, so many factors to consider that direct comparisons between this and other types of oxy-acetylene welding and between the oxy-acetylene and the electric arc methods cannot be made. According to Lawrence Massa, who was in charge of the laying of this line for the Southern California Construction Company, the new process used costs less than the oxy-aceteylene methods previously employed by that company. The saving was both in time and material, that of the latter being indicated on the drawing, where the weld is but little greater than the top of the bevel of the pipe and where the weld metal is lessened to a considerable extent by the angle of the bevel. On this 16-inch line he said that some men would make as high as 20 welds per day, but the unusual conditions encountered in some sections naturally brought the average to a considerably lower figure. The speed of the process is limited only to how fast the rod can be melted. It is claimed by the designers that a bevel greater than that shown involves a waste of time and material in welding up an unnecessary space. The rod used on this job was one recently developed and is made of a special composition giving free, fast flowing qualities that will produce a weld metal of high tensile strength.

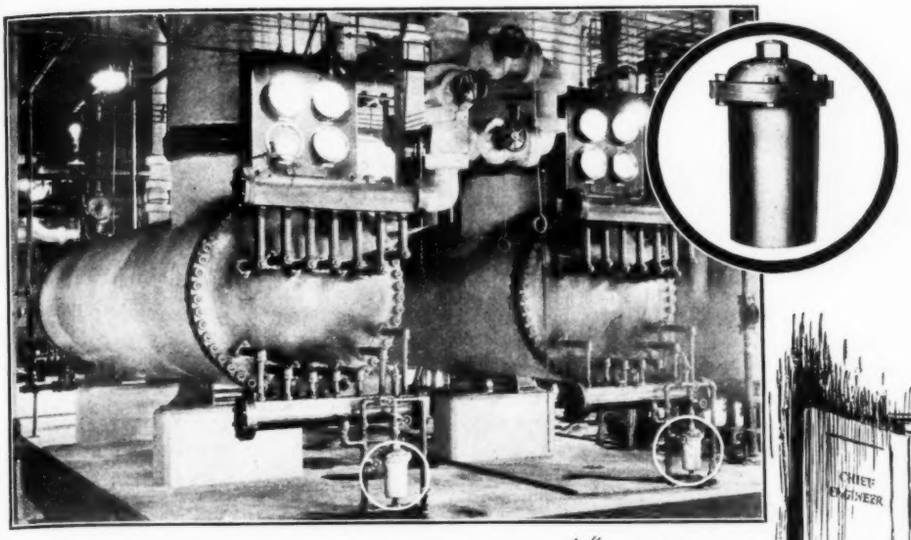
The use of lugs for lowering the pipe into the ditch protects the coating from injury.



Bringing the line up a steep rise from the ocean level.

Except for the use of large size welding tips, no special equipment is employed in this process. Only about 0.01 inch of the wall is broken down by the heat, and this also is influential in producing a greater speed of welding. It has been estimated that, under average pipe line conditions, it requires one minute's welding time for each inch of diameter of pipe on a rolling weld. In other words, a 16-inch pipe should require 16 minutes for the completion of a joint. On stationary or overhead welds it will probably take from 25 to 50 per cent longer. These estimates of time, of course, consider only the actual time spent in making the weld and make no allowances for preparation, moving, etc.

On this 16-inch line, dollies were used throughout. It has been found that the small extra cost in supplying this equipment is well repaid for all lines of 12 inches diameter or over. Other convenient devices were also found to be an advantage in the laying of this line and, when the location was beside the highway, a tractor was used for lining up. The general practice in California is to use cranes for lowering the pipe into the ditch wherever they can be readily moved along the right-of-way.



Armstrong traps in refinery of Sinclair Refining Co. at Wellsville, N. Y.

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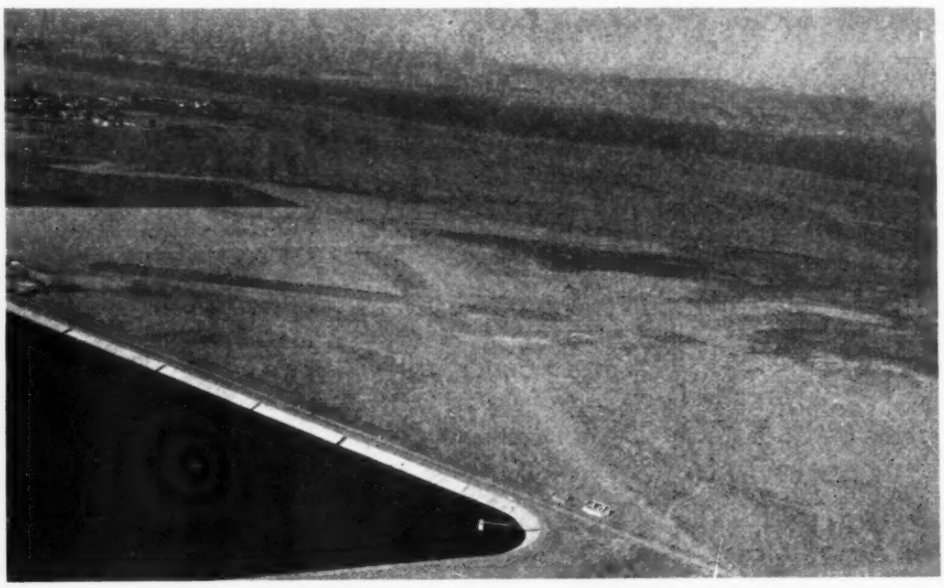
OIL COMPANIES

By E. B. BRONTE, *Manager Aviation*

THE larger oil companies throughout the nation are lending their wholehearted support to aviation, the infant industry, not because of philanthropic inclination but because they see in this infant an industrial giant of the future. They can visualize the sky lanes being traveled by individually owned airplanes as numerous as the automobiles on the highways, and a huge network of air transport lines interwoven across the surface of the country carrying mail, passengers and freight between every city and hamlet. They can even foresee regular air services from the Pacific Coast to the Hawaiian Islands and on to Australia and the Orient, and from the Atlantic Coast to Bermuda, the Azores and Europe.

Such a vision is not impractical, nor is it impossible, for today airplane manufacturers are concentrating on small sport type planes having high factors of safety and being extremely simple to operate in flight. A plane of this type was recently demonstrated by its pilot, who landed the plane while holding his hands high above his head. Imagine parking an automobile in that manner.



Associated Oil Co. airport at Avon, Cal.

Huge flying boats now negotiate the ocean stretches between the Atlantic Seaboard and the West Indies and on across the Caribbean to South America with ease and without incident daily. The Post Office Department will soon call for bids to be submitted by air line operators, providing for the establishment of air mail service across the Atlantic by way of Bermuda and the Azores.

There is every indication that the aviation industry will not only parallel the automotive industry, but will emulate the scope of activity of the railroads as well.

In fostering the growth of aviation the oil companies are tireless in their efforts and generous to a fault. Their aviation representatives or flying oil salesmen call with their planes at every airport within their territories, selling the local commercial aircraft operators, if possible, persuading timid individuals to make their first airplane flight and educating the public regarding the advantages to be derived through the use of aircraft and the safety thereof.

The oil companies in many cases sponsor aeronautical events such as record flights, air races, air shows and expositions, and in practically every instance participate in them to a certain extent. They advise communities regarding landing field sites and their development into first-class airports.

In California the State Chamber of Commerce has appointed a committee known as the Landing Field Development Committee, the purpose of which is to carefully survey every airport within the state and, when necessary, cause the removal of hazardous obstructions, the improvement and repair of unsuitable runways, arranging for the correct installation of necessary facilities, the compilation of data pertaining to all airports, and the issuance of same to the aeronautical industry and every detail pertaining to the proper development and care of an airport. Naturally the committee is composed of men thoroughly conversant with the subject of airport construction, development and maintenance, and its personnel consists almost entirely of oil company aviation representatives.

Every oil company of any consequence on the Pacific Coast operates at least one airplane, and in one instance a company operates six planes, two of which are tri-motored transports. Our own plane is a Boeing biplane, powered with a 525-H. P. Pratt & Whitney Hornet engine, and of the same design and construction as the plane used by the air mail operators throughout the country. It has two open cockpits, equipped with dual control, and has a two-passenger cabin located between the wings. Just forward of this cabin there is a baggage compartment with a capacity for 500 pounds of baggage. This plane was purchased by us on September 5, 1928, and since that time it has been flown 1,419 hours over a distance of 135,066 miles without accidents of any nature whatsoever, and without a single case of motor failure. Also, during the period of operation of our plane we have carried 3,209 passengers, the majority of whom were flying for the first time. Our executives regularly use our airplane for making rapid trips through the territory, and our geology department uses it to great advantage in surveying oil lands.

AND AVIATION

Department, Associated Oil Company

On November 1, 1930, we dedicated our airport, which we constructed on a portion of our refinery property at Avon, California. This landing field is equipped with cross runways, permitting planes to land into the wind regardless of the direction from which it might happen to be blowing; hangars have been erected, a gasoline pump installed, and a flying school has been established to operate at the field, which has 14 students enrolled at the present time. Numerous army and navy pilots and also commercial flyers land at this field, from whence they are conducted to our refinery, one mile distant, and shown through its laboratories and various manufacturing units.

Several oil companies have provided for aviators what might be termed airway road signs by painting the name of the town or city in which each one of their plants is located upon the roof of the plant. Flying men are universally grateful for this contribution to safety in the air, and have shown their appreciation by patronizing whenever possible the oil companies who have so willingly assisted them in this manner.

George Dixon, assistant manager, aviation department, Associated Oil Co., and plane "Motormates."

California leads the nation in the number of airplane pilots and mechanics, there being 2,852 of the former and 1,665 of the latter licensed by the Aeronautics Branch, United States Department of Commerce. The large volume of regular air mail and scheduled air transport operation within this state is to a great extent responsible, as these concerns employ large numbers of pilots and mechanics, the balance being engaged in student instruction, scenic passenger flying, aerial photography and in the manufacture of aircraft and aircraft engines. The major transport operators are Transcontinental and Western Air, Incorporated. This service extends from San Francisco to Los Angeles and through Arizona, Mexico, Texas, Oklahoma, and on to the Atlantic Seaboard. The Western Air Express operates an air mail service between Los Angeles and Salt Lake City. The Pacific Air Transport operates an air mail and passenger route the entire length of the Pacific Coast from San Diego to Seattle. The Boeing Air Transport, with terminals at Oakland, Calif., operates an air mail and passenger service to Chicago, and the West Coast Air Transport conducts a passenger service between Oakland, Portland and Seattle.

In the State of California there is great activity in the manufacture of aircraft, there being approximately 10 aircraft factories in Southern California alone. These factories produce flying boats for the navy, observation planes for the army and fast transport planes for commercial aviation. There are also small manufacturers located in other parts of the state and throughout Oregon and Washington. However, at Seattle, Wash., one of the largest airplane factories in the world is located, wherein the construction of hundreds of various types of army and navy and commercial airplanes takes place. This is the Boeing Airplane Company, to which aviation enthusiasts proudly point as the largest industrial unit in the city of Seattle.

In the United States today there are 25,000 miles of airways over which air transport lines daily fly a distance of 90,000 miles. Sixty per cent of this flying is done after nightfall over the lighted portions of the airways and, with the completion of new lighting facilities which are now under construction, many of the operating lines plan to double their present schedule. Probably the feature of greatest importance to the general public in this connection is that the statistics published by the Aeronautics Branch of the United States Department of Commerce states that there is only one fatality for every one million miles of flying over these regularly scheduled air transport lines. Structural failure is unheard of in the airplane of today, and the same must be said for fire in the air. Aircraft engines have been developed to such a high degree of perfection that with proper care they can be operated for thousands of hours. Engine failure during flights practically never occurs with these new production engines. Stormy weather, with its fog, rain, sleet and snow, the greatest enemies of air transportation, creating a hazardous condition due to lack of visibility, will in the not too distant future be overcome by the application of the radio telephone, radio directional beam, electric altimeter, the artificial horizon and the Gyro pilot. The last-named instrument makes it possible for the airplane with which it is equipped to fly at any desired altitude through fog and storm with an accuracy which could never be attained without it. By means of the radio telephone the aircraft is kept in constant communication with the stations located at the airports along its route. With the radio directional beam the plane is unerringly guided to the airport obscured by fog. A landing may then be effected by the pilot by the use of the artificial horizon and the electric altimeter indicating the exact distance of the plane from the ground.

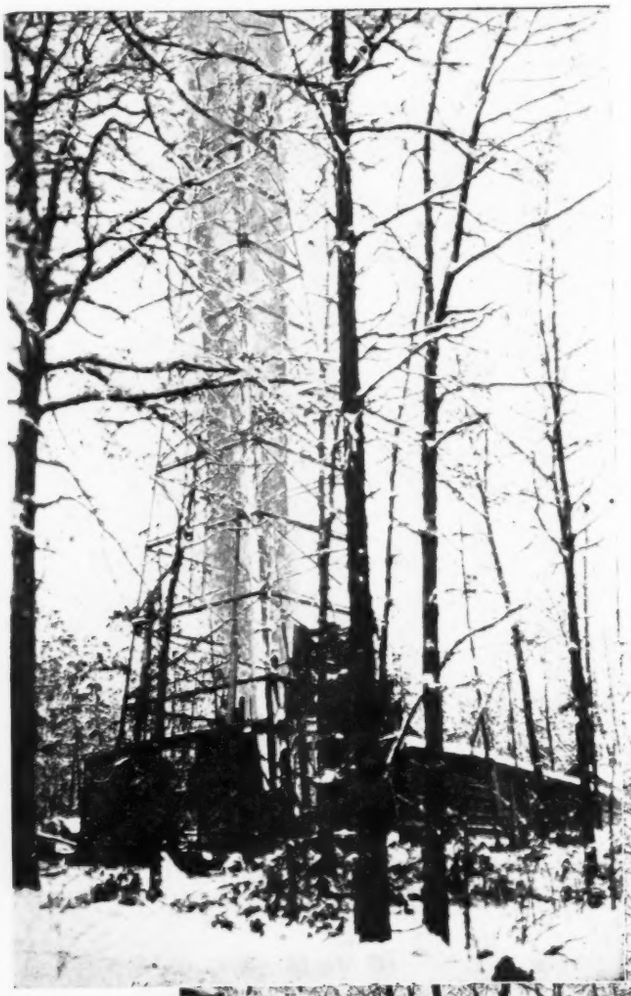
Largest Eastern Gas Well Near Tioga, Pennsylvania

WHAT is declared to be the largest gas well east of the Mississippi River blew in on the Ben Meaker farm, a few miles north of Tioga, in Tioga Township, Tioga County, Pennsylvania.

On February 17, 1931, while the well was drilling at a reported depth of 4,197 feet, gas was struck and the well started to produce at the rate of one million cubic feet daily. Increasing its flow gradually to six million cubic feet the well is reported to have drilled itself in. Suddenly increasing in volume to 40 million cubic feet per day on the afternoon of February 20, 1931, the well got out of control. The rate of flow kept on increasing until the well just before being capped was producing at a rate variously estimated at from 75 to 100 million cubic feet per day.

A well of this size and producing from such depth in this region is somewhat of an event. It was an unexpected and unusual difficulty faced by the Penn-United Gas Company, the owners of the well. Undaunted by the job, the company immediately set about making arrangements to cap the well. The details of how this was done and the particulars regarding the condition of the well at this writing are not available.

It is known that among others on the scene to lend their aid in capping the well in proper manner, was a special crew of men in charge of C. P. Parsons of the Halliburton Oil Well Cementing Company, Duncan, Oklahoma, whose ability to handle difficult operating problems is well known. This company dispatched one of its large motor-driven outfits mounted on a six-cylinder truck with two men to drive it. On the way east the truck was driven continuously day and night, the two men alternating at the wheel.



Above—Tioga County well blowing wild. Right—Well before being drilled.

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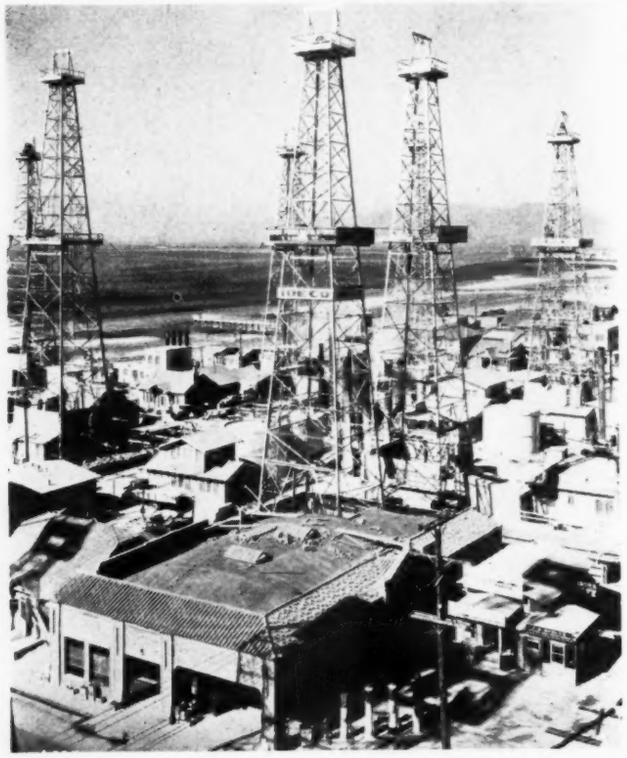
VENICE . . Where No Lot Is Too Small for a Well

THE slogan in Playa Del Rey, at Venice, California, seems to be "Every lot a well." Development is slowly extending to the southward, with additional locations consistently being made. In the earlier developed areas, the few town lots that were not, for some reason, previously drilled are now being given attention and no available location is being overlooked. Both old and modern types of equipment are used for drilling and some of the latest designs in pumping units have been installed on many of the wells.



A derrick extending up through the roof of a garage in which a well is being drilled.

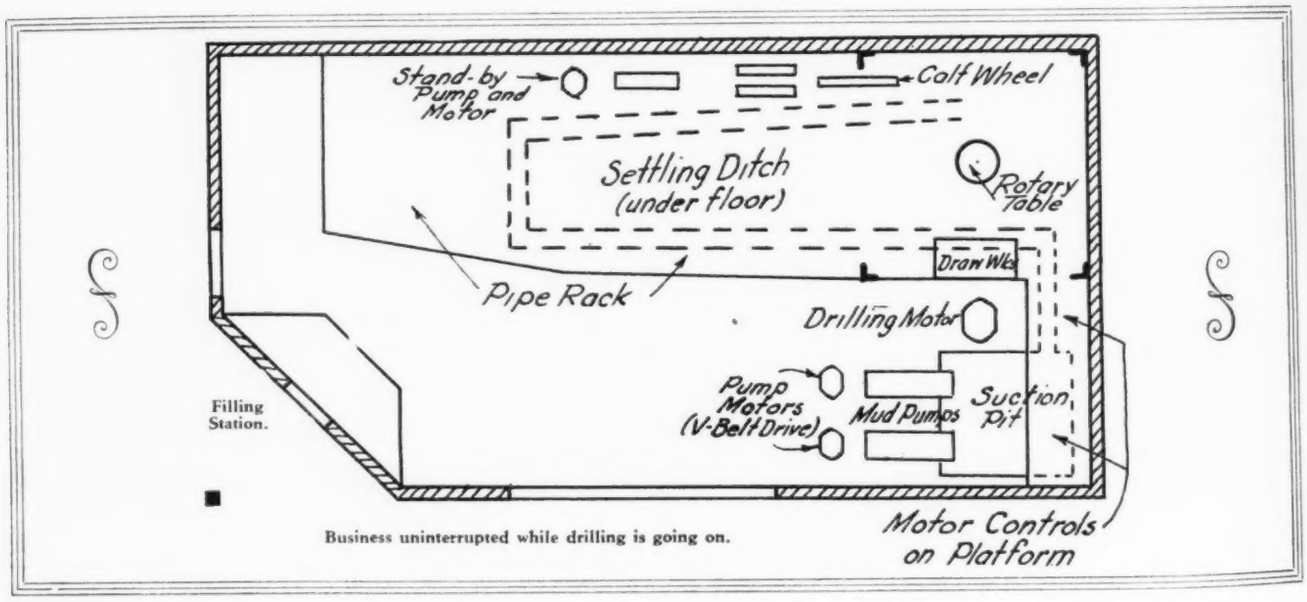
Drilling methods have ranged from bad to good, as can be expected in a town-lot area where promotion schemes are the vogue. The few larger companies, of course, conduct their operations in accordance with standard practices. Most of the wells, however, are being drilled by inexperienced companies.

In many cases the material and labor are furnished on faith, hope or charity with payment to be made after production is obtained.

Equipment varies from the poorest to the best and latest designs. Accidents have been many and frequent, with emergency hospitals conveniently located all over the field.

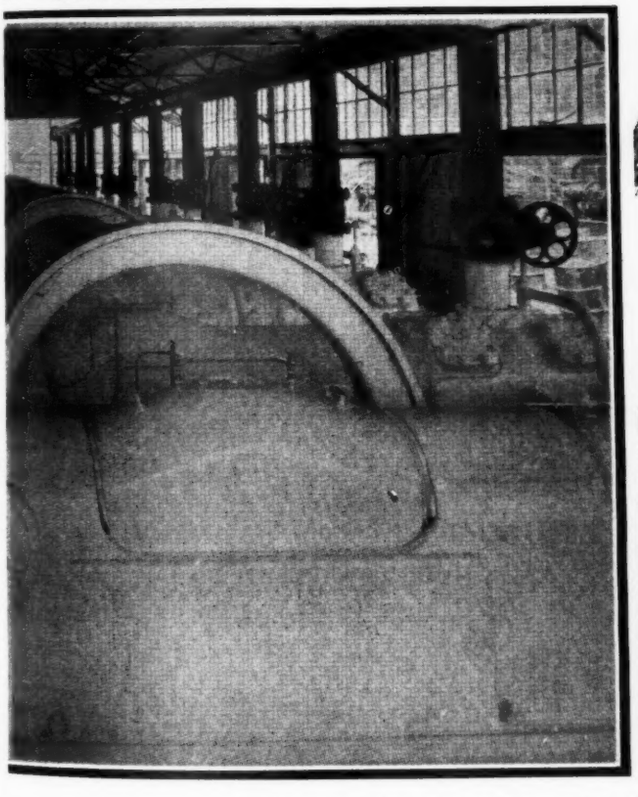
The formations encountered offer little difficulty to the bit and the gas pressure is so low that completions are readily made. There are two productive zones—one at about 4,000 feet and a deeper one at approximately 6,000 feet. Some of the wells are drilled only to the upper zone, but more produce from the lower. The deeper zone is a conglomerate and contains boulders of varying sizes. It is about 100 feet in thickness and underlaid by a schist bed. There are numerous geological conditions which indicate that no deeper horizons may be expected.

One of the wells which is producing from the 6,000-ft. depth shows an unusual log when plotted with a time-depth curve. This well was drilled with the latest type of equipment and the actual drilling time was very fast. Including the time consumed in coring, the total depth was drilled in only 36 days. But the well was not completed and put on production until after 70 days had elapsed after spudding in. The curves on this well clearly indicate the time consumed in making hole compared to the total elapsed time. It is interesting to note that the 9-inch casing, which was cemented at 3,749 feet, was not run until a depth below



Business uninterrupted while drilling is going on.

NAME THAN EVER

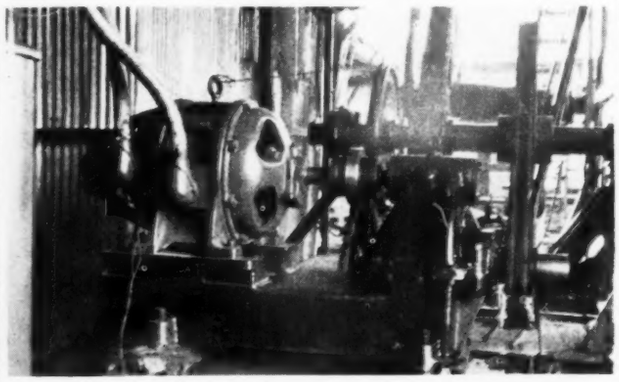


The CLARK line includes gas engines, and engine and motor driven compressors ranging from 40 to 400 H. P. Each is a highly perfected machine, accurately adapted to today's requirements in the industry.

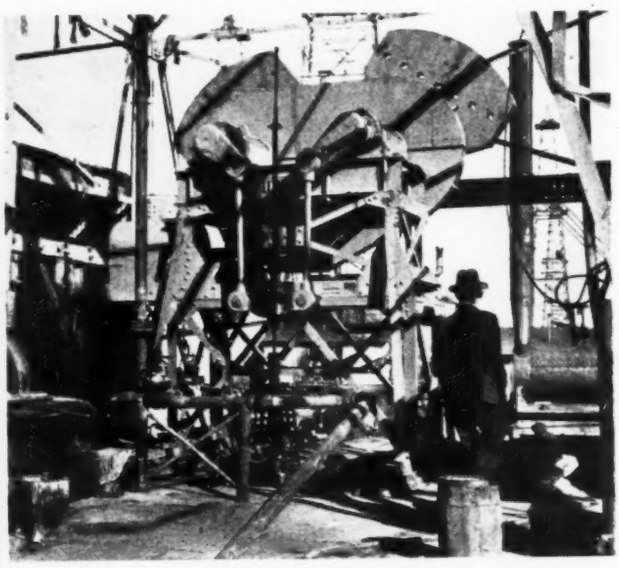
CLARK BROS. CO., Olean, N. Y.

Export Office: 150 Broadway, New York City. Mid-Continent Sales Offices: 125 West First St., Tulsa; 910 Bankers Mortgage Bldg., Houston. Warehouses: Tulsa, Oklahoma; McCamey and Sweetwater, Texas; Artesia, New Mexico. California: Smith, Booth, Usher Company, 228 S. Central Ave., Los Angeles.

6,000 feet had been reached. Other interesting facts were revealed by the well's record. The time spent in coring was well worth while and the amount of coring being done throughout the field has been advantageous in many ways.



The combination pumping and pulling unit is a recent development that is being used on a Blueridge Oil Co. well at Venice.



This pumping unit, motor driven, is operating at a speed of twenty strokes a minute.

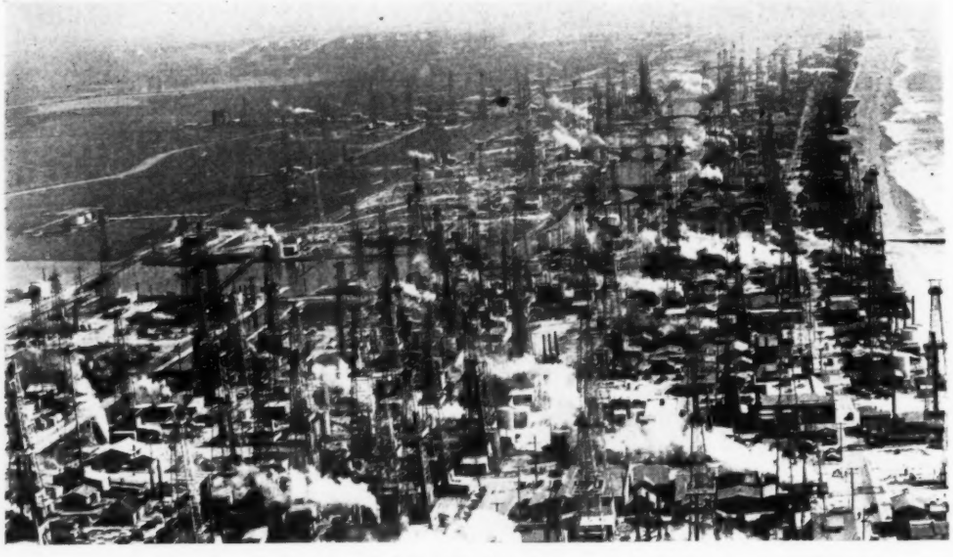
"Every lot a well" means more than just a well on every lot. For the lots are so small that practically every one is taken up completely with the drilling equipment. One of the latest wells started is in a garage. The garage covers the entire lot on which it is located, and since it is desired to use the garage for its original purpose after the well is completed, it was kept intact to as great an extent as possible. A portion of the roof was cut away to permit the derrick to extend through it; and this was located at one corner. This, and the arrangement of the other equipment, are shown in the accompanying sketch. Garage service is, of course, interrupted during the drilling operations, but the filling station is still doing business.

Several new production devices have been installed on the pumping wells. One of these is a new combination pumping and pulling unit designed to serve the operator who does not have a sufficient number of wells to warrant the investment in a portable pulling outfit. An illustration shows the one installed on a Blueridge Oil Company well.

A picture shows the well pumping on the beam. It is driven by a 65/25 h.p., two-speed, double-rated, oil field motor which powers the drive sprocket through a reduction gear. The drive sprocket governs the pumping speed and one with 15 teeth gives 15 strokes per minute, while one with 24 teeth gives 24 strokes per minute. The length of stroke is obtained with a standard A.P.I. 4 or 5-hole crank which is driven by a 94-tooth sprocket connected to the drive sprocket with a double roller chain. The well pulling is performed through a standard A.P.I. calf wheel drive, 42-tooth clutch sprocket which drives either a calf wheel or production hoist. The 25 h.p. side of the motor is used for pumping and the 65 h.p. side for pulling. The rods and 2½-inch tubing from a depth of 4,200 feet were pulled and the well put back on production in five hours with this unit.

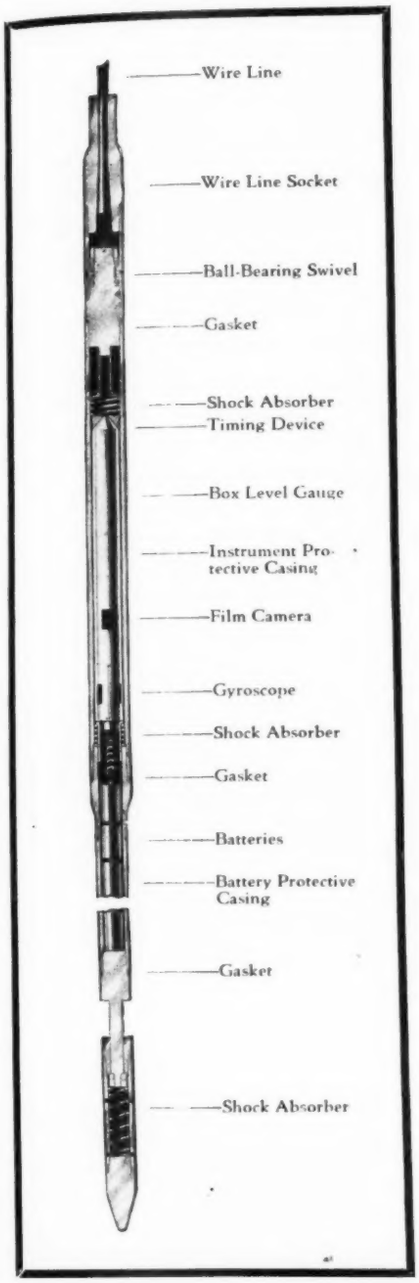
A new pumping unit has just been installed on one of the wells as shown in an accompanying photograph. This is self-contained and driven by an electric motor incorporated in the unit. The two counterbalances can be seen on the beginning of the up-stroke of the rods. The movement of the one on the right is clockwise and of the one on the left, counter-clockwise. The rod motion is kept vertical throughout its travel.

When the oil is produced it is sold in any way possible. Contracts of many kinds have been made and the producer and purchaser make their agreements without fixed standards. Gravity has little, if anything, to do with the price. Free lectures are given daily to the visiting "oil men" and "oil women" from the farms and cities throughout the land. Stock is still being sold. With several wells to the acre; with an upper zone productive in only a portion of the field; with a deep pay of about 100 feet of conglomerate; with a low gas pressure at 6,000 feet; with shallow wells costing from $30,000 to $40,000 and the deep ones from $80,000 to $100,000; and with the oil selling for not over 65 or 70 cents—the economics of the proposition do not present a rosy aspect.



The Playa Del Rey Field at Venice, California, from the air. —Photo by Spence

SURWEL SERVICE



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With the aid of the gyroscope we have been able to make an instrument which will not only accurately tell the degree of deviation in drilling, but will exactly tell the direction of such deviation. No producer needs to be told how invaluable to him such a surveying service can become.

The Surwel Gyroscopic Clinograph has been subjected to exhaustive field tests over a three-year period. The service is now available to operators in making complete and accurate surveys of wells or bore holes in the shortest space of time. Write for literature.

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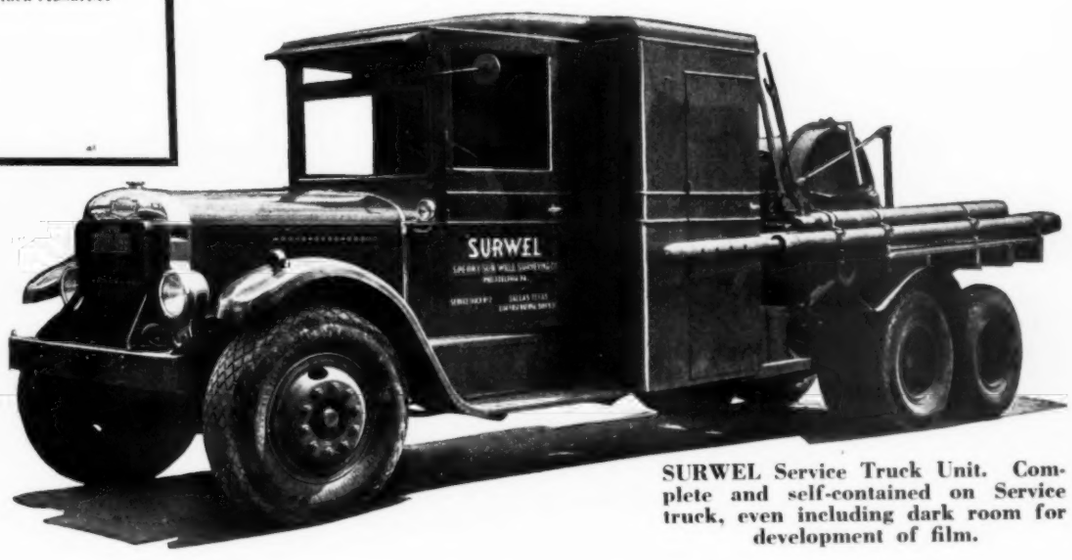

SURWEL Service Truck Unit. Complete and self-contained on Service truck, even including dark room for development of film.

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Locating Point of » » »

Water Entry *in a* California Well

THE locating of the exact point at which water is entering a well always presents difficulties which must be overcome by the use of the best methods and by the most careful attention to details of procedure. However, when a well comes in with a big initial production accompanied by a large volume of gas under high pressure, the problem of determining the source of any water which cuts the oil presents added difficulties. A big well recently drilled in one of the Southern California fields started cutting as soon as completed and solving the problem which it presented clearly demonstrated that the point of entry of the water can be determined under adverse conditions.

The well had an estimated initial production of over 9,000 barrels of oil per day with about 9,000,000 cubic feet of gas. The 9-inch casing was cemented at 3,525 feet with a liner set from 3,475 feet to 3,857 feet. About 250 feet of the liner was perforated. The well showed only a small cut, but it was most desirable to locate the source of water accurately in order to establish casing programs for other wells and to plan future drilling.

An electrical method using resistance to show the point at which the water was entering the well was used. By this method, a well is first put into condition by providing a fluid column in the well measurably different in composition from that of the entering fluid. Two electrodes, encased in a container, are then lowered into the well on a cable and the resistance of the fluid, when a current is passed from one to the other, is measured in ohms at the surface. Fresh water gives a resistance of from one to two-thousand ohms while sea water gives only 40 ohms. The difference in resistance given by the entering water is thus immediately indicated when the electrodes are lowered into the well to that point. Location of the source of water is determined accurately and within very close limits.

The greatest difficulties to be overcome in a big well flowing with high pressure are those of providing a foreign column of fluid in the hole and of lowering the electrodes with complete control. In studying this well, it was first killed by pumping in cold oil; but in less than 24 hours it started flowing through the casing.

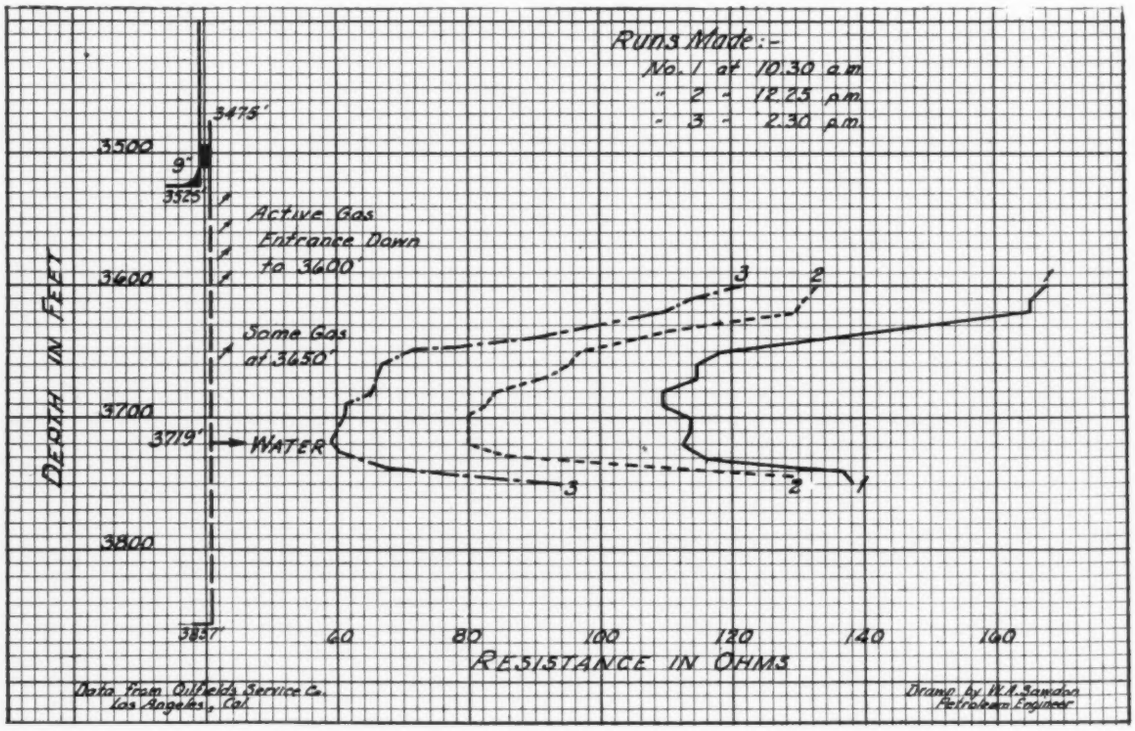
The well was then washed by pumping a stream of water into the tubing. Following this, and continuing throughout the study, water was pumped into the tubing, first having been metered to maintain an input at about twenty barrels an hour. The flow from the casing was allowed to continue and this production estimated to be about one hundred barrels an hour. A back pressure was thus held, the pressure in the casing varying from 300 to 400 pounds.

A preliminary run was first made to bottom with the instrument. This gave little information, however, since an uncontrolled flow through the tubing started as soon as the instrument was pulled back to the top of the perforations in the liner.

The well was then reconditioned and a series of three runs made with the well flowing through the casing as a means of removing the fluid. During the time these runs were being made, water was metered into the tubing at a rate of about fifteen barrels an hour. At the termination of the third run, however, another controlled flow started through the tubing.

The flow through the tubing had to be killed again. Seven successful runs were then made with a constant stream of water going into the tubing at all times and the stream greatly increased while the cable was being pulled after each run. Thus the gas was prevented from breaking through the water column in the tubing as the instrument containing the electrodes was drawn above the perforations.

In this illustration is shown the result of three of the seven final runs. From these the source of water was determined to be at 3,719 feet, where the resistance due to the salt water had a minimum value. The volume of this water was small, but its salinity, as determined by its measured resistance, was nearly equal to that reported for the well water.



The FIRST

commercially successful method of treating "cut oil" and "B.S." is STILL FIRST in ECONOMY, CONVENIENCE *and* CERTAINTY OF RESULTS

The Tret-O-litE Process is favored today by the majority of oil producers because it costs but a few cents per barrel, is easy to apply and recovers every drop of oil from "cut oil" or "B. S." Experienced operators also know that they can depend on the expert service rendered in all districts by representatives of the Tretolite Company.

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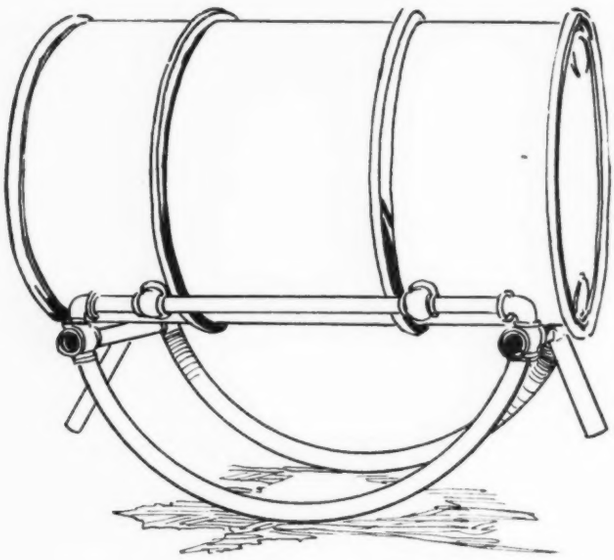
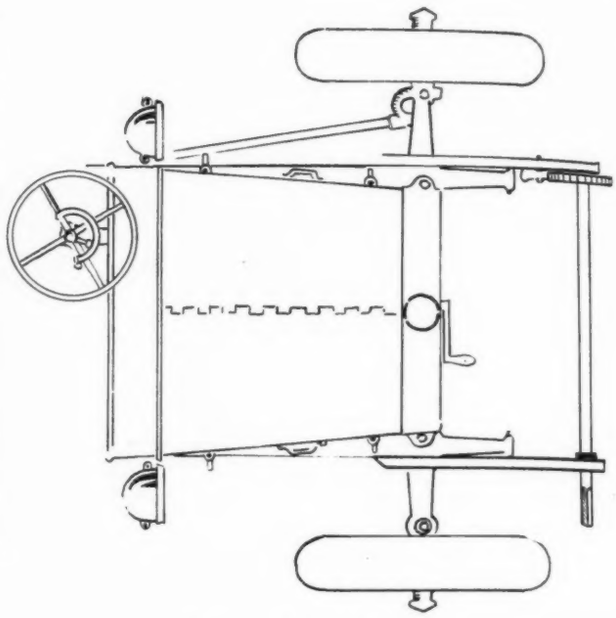
TIME *and* TROUBLE SAVERS



Handling Drums in the Field

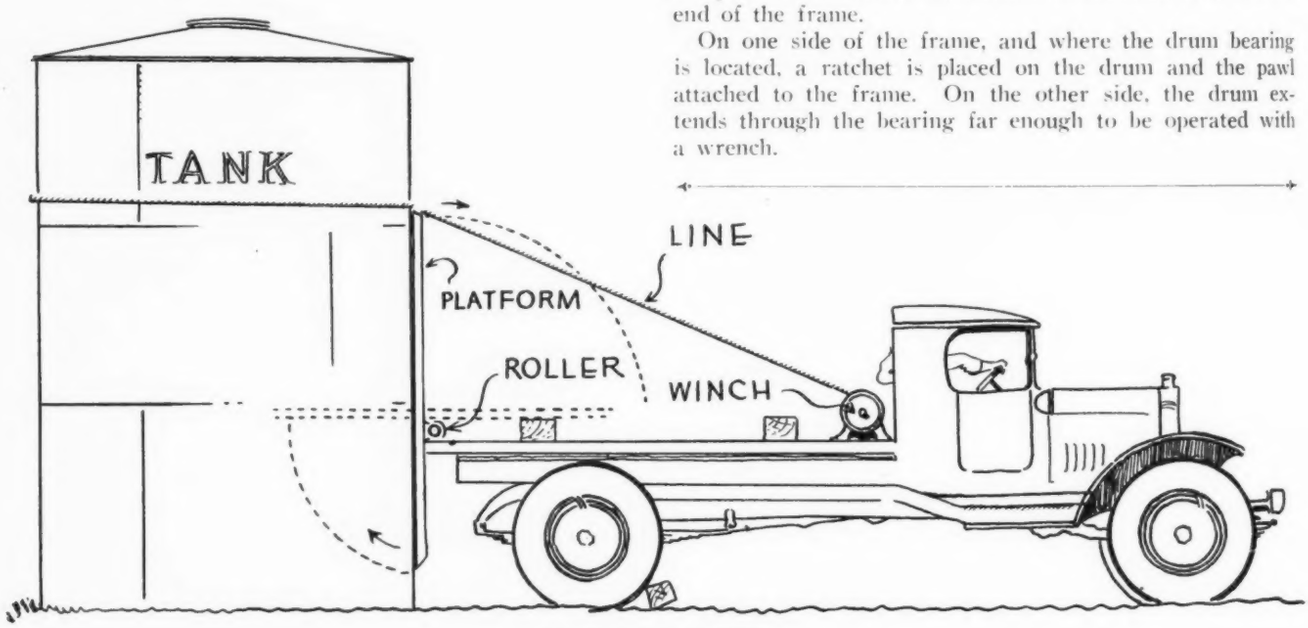
TO enable easier handling and draining of oil or gasoline drums in the field they may be placed on a rocker base, which will permit tipping of the drum. A feature of this device is that short legs are placed at the top of the rockers. This prevents the rocker from dipping so far that it will let the drum slide off. The accompanying illustration shows the construction.



Pull-out Device for Trucks

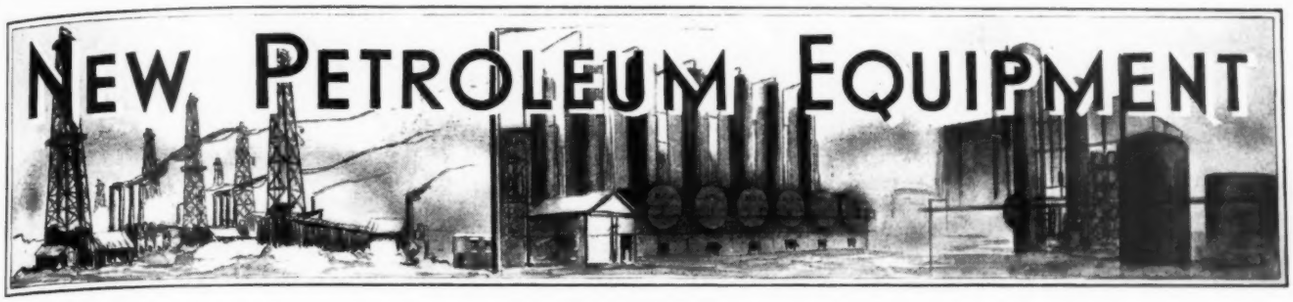
FREQUENTLY trucks in pipe line service not equipped with winches are sorely in need of one for a "pull out," or to load or unload equipment. For such requirements one company builds an inexpensive winch on the front end of the truck. The trucks are not equipped with bumpers and a welded steel frame is attached to the front end of the frame.

On one side of the frame, and where the drum bearing is located, a ratchet is placed on the drum and the pawl attached to the frame. On the other side, the drum extends through the bearing far enough to be operated with a wrench.



Loading Small Tanks

A VERY simple method of loading small work tanks onto trucks has been devised by Ernie Bell, Deep Rock Oil Company, Drumright, Okla. A small flat table is attached to the truck bed at the back by means of a roller. The roller permits the table to flip upright when the truck is backed into the tank. The winch line passes over the table and is attached to the tank. When the line is pulled the table tilts with the tank to a horizontal position.



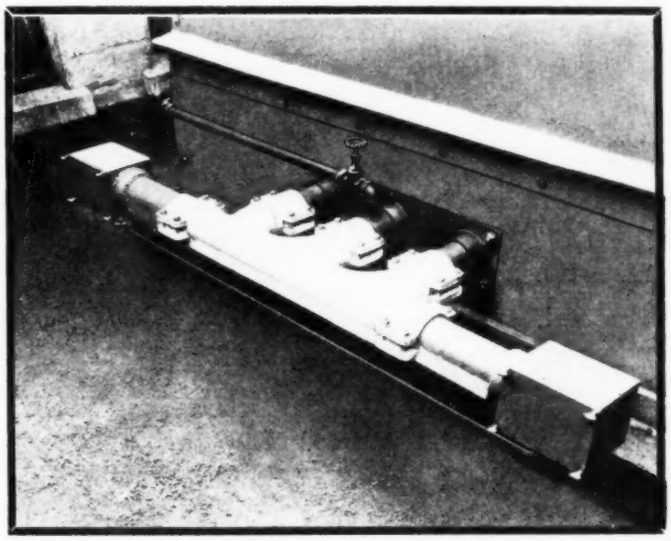
Direct-Current Drive with Generator Voltage Control

THE General Electric Company announces a direct-current drive, with generator voltage (Ward Leonard) control, for application to oil well rotary drilling rigs. This makes available for oil well drilling the many advantages of direct-current drive with drooping generator voltage characteristics and generator field control so successfully used in other applications.

Each drive consists of two duplicate direct-current generators with direct-connected exciters, one or two direct-current motors for driving the drawworks, two duplicate direct-current motors for driving the mud pumps (one being a spare motor), and the necessary control and protective equipment. The generators may be driven by a single or two separate electric motors, or, if central station power is not available, by duplicate internal combustion engines.

L. & N. Smoke Recorder

LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., has recently placed on the market the L. & N. Smoke Recorder, which consists of a measuring chamber at the stack of breeching, a recorder at any convenient location and an indicator at the boiler, for the purpose of maintaining minimum smoke conditions to meet ordinance requirements or for purposes of economy.

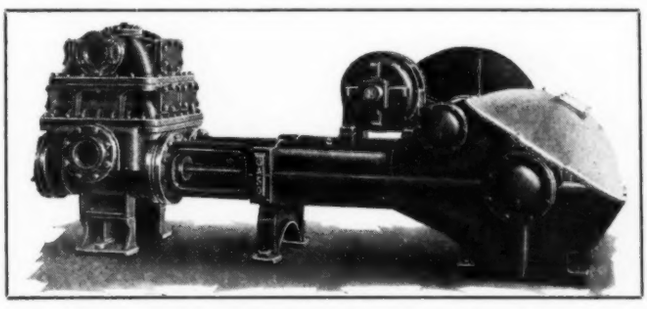


The measuring chamber, through which the smoke passes, contains a lamp at one end and a specially constructed, temperature compensated thermopile at the other. Heat radiated from the lamp passes through the smoke-filled chamber and falls on the thermopile. With a constant heat-source in the lamp, the amount of heat falling on the thermopile is inversely proportional to the density of the smoke. The heat from the lamp which reaches the thermopile causes it to generate a voltage. The measurement of this voltage is the measure of the smoke density.

The recorder is a standard L. & N. Potentiometer Recorder. It measures the voltage of the thermopile and reads directly in per cent smoke density or Ringelmann chart numbers. The boiler-room indicator is a bank of five lamps. The color of the lamp burning instantly tells the fireman the smoke condition in the stack.

Gaso Suction Pump

A NEW addition to the Gaso line of pumps is the Gaso Enclosed Type Suction Pump, which has an 18-inch stroke and a fluid end taking interchangeable liners from six-inch to 10-inch. Among the features designed to render this pump economical in operation are Timken Tapered Roller main and pinion bearings, sealed off from the crank case.

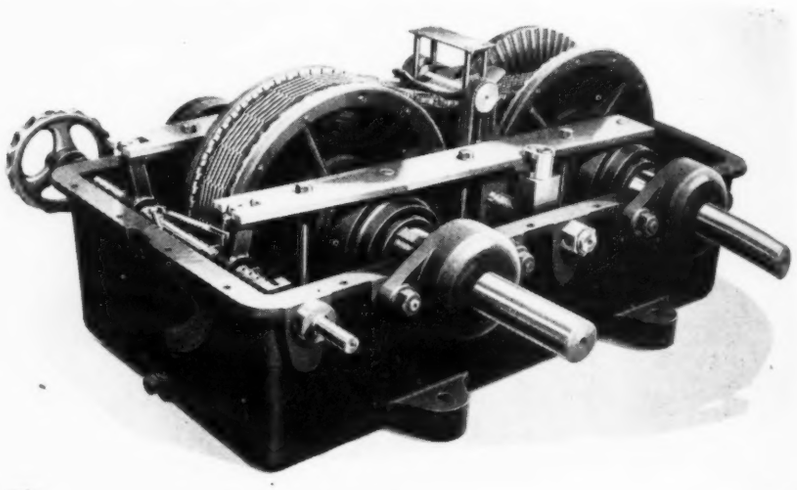


The connecting rod crank end bearing is equipped with removable sheet steel, babbitt lined. The gear is semi-steel and the pinion gear is forged steel, both of wide face, stub tooth construction, running in oil. Valves are of Monel metal, of light construction, with bronze seats. The frame is of sufficient length to avoid overlap of piston rods. This new pump can be arranged for top-mounted motor drive or for any other type of drive desired.

Detailed information can be obtained from the Gaso Pump & Burner Mfg. Company, Tulsa, Oklahoma.

Link-Belt's Variable-Speed Transmission

WHAT is said to be the first all-metal variable-speed transmission on the market has recently been announced by the Link-Belt Company, Philadelphia. It is called the P. I. V. Gear, the initials standing for "Positive Infinitely Variable."



Basically, this new speed change unit consists of two pairs of wheels of the opposed conical disc type, between which a unique chain transmits power. The effective diameters of each pair of wheels can be altered under load to change the speed ratio, without steps and without dependence upon friction. On changing speed, the self-pitching chain rises in one set of wheels and descends in the other, so that while the input shaft connected to a motor or other source of power turns at constant speed, the output shaft is brought to the desired R. P. M.

A book, No. 1274, illustrating and describing the Link-Belt P. I. V. Gear, will be sent gratis upon request to Link-Belt Company, Philadelphia, Indianapolis or Chicago.

Advanced Design of Fluor Cooling Towers

THE Fluor Corporation, Limited, of Los Angeles, Calif., announces that a number of new features of advanced design have recently been incorporated in the Fluor Cooling Tower which tend to greatly increase its efficiency, as well as simplifying and standardizing its construction.

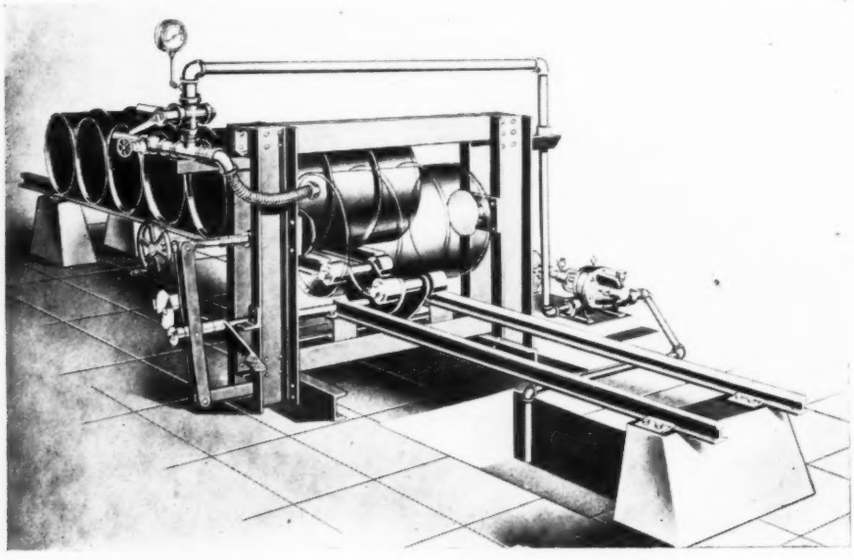
The following are some of the more important improvements that have been incorporated in the new tower: the primary distributing system on top of the tower has been revised so that in place of the old flume and troughs, a pipe system is now used in conjunction with a modification of the Fluor bowed type double paneled deck. This, it is claimed, gives practically perfect distribution of water and requires no adjustment, since there are no troughs to get out of level, and the growth of algae cannot affect distribution.

Another feature is the reduction in spray loss caused by wind velocity. The tower has been designed so that it offers maximum obstruction to the water which is trying to get out of the tower, and yet does not prevent free circulation of air.

A complete and detailed description of the new Fluor tower will be forwarded upon request to the company.

Horizontal Hydraulic Drum Cleaner and Dedenter

THE Watson-Stillman Co., Roselle, N. J., has added to its line of barrel house equipment a new machine for reconditioning steel drums.

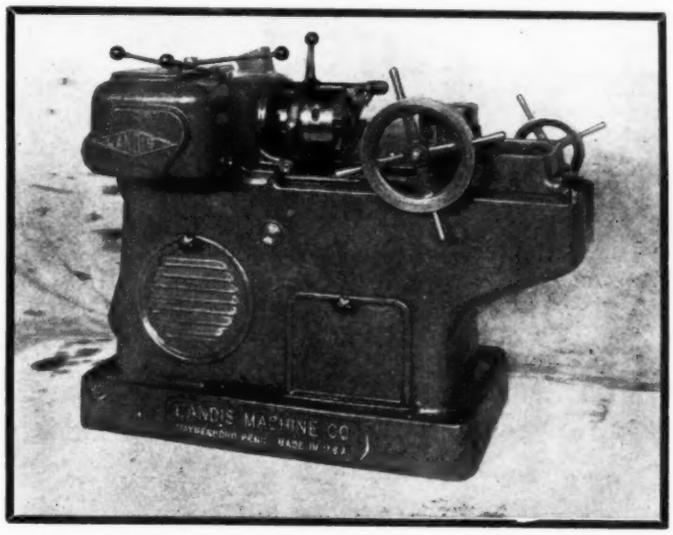


The machine illustrated dedents, cleans and tests in one operation.

The drum to be reconditioned is rolled from the back rack on to the rocker saddle, clamping heads tightened, and a flexible hose is connected to bunghole bushing with quick locking coupling. An alkaline solution from the sump is pumped into the drum. The pump then builds up hydraulic pressure as indicated on the gauge to dedent and at the same time test the drum.

To complete the operation, the pump is by-passed by the three-way valve, the hose is disconnected, clamping heads are released and the rocker saddle is tripped by the foot pedal, allowing the drum to roll on to the rack to drain into the sump. The solution is, of course, used until its strength is spent.

Landmaco Threading Machines



THE Landis Machine Co., Inc., Waynesboro, Penn., has placed on the market a thoroughly modern threader known as the Landmaco threading machine. This machine is of a new design characterized by strength, rigidity, wearing qualities and a capacity for producing accurate screw threads, according to the manufacturers.

The Landmaco threading machine is made in the single and double head models. In keeping with the general design of the machine, it will be equipped with heat-treated and ground Lanco heads.

The machine has a single pulley drive with a friction clutch to start and stop the machine. The clutch is adjustable and as it is mounted on the outer end of the main drive shaft it is readily accessible.

Full particulars and description of this new threading machine will be sent to anyone writing to the Landis Machine Co. at Waynesboro, Pa.

Two-Speed Oil Well Pumping Motor

THE General Electric Company has extended its line of type M.T.O. two-speed oil-well pumping motors to include a new and larger rating, 75/35 horsepower. The other ratings already available and in use are 35/15, 50/20 and 55/25 horsepower. The new 75/35 horsepower motor has been designed with all the characteristics of the other motors of this line. It is designed for 440 volts and suitable for operation on 3-phase circuits, either 50 or 60 cycles. It operates on a 6-pole connection on high speed and a 12-pole connection on low speed, giving synchronous speeds of 1200/600 r.p.m. on 60 cycles and 1000/500 r.p.m. on 50 cycles.

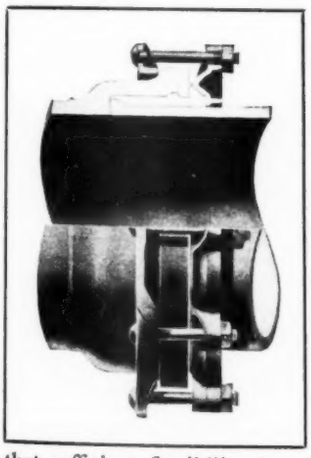
The low speed connection is used almost exclusively for individual well pumping. The high speed connection is used for all other service work at the well, such as pulling rods and tubing, etc. The motor is of the wound-rotor type with six collector rings, thus enabling speed variation, to be obtained on both the high-speed and low-speed connections, using the same control equipment in either case.

The MacCreedy Fluid Level Indicator

J. H. BUNNELL & COMPANY, INC., 215 Fulton St. New York, has announced the manufacture and sale of the MacCreedy Fluid Level Indicator, which makes it possible from an instrument panel set up in the pump station or at any point miles distant from the tank farm, to take readings of the fluid levels in as many tanks as necessary.

The MacCreedy Fluid Level Indicator is a simple, scientific "remote control" gauge, which automatically indicates the fluid levels of reservoirs or storage tanks within an accuracy of one-eighth (⅛) of an inch. It is said to eliminate the hazards of manual gauging, is accurate, and offers continuous readings at one or more points 24 hours per day.

Dresser Repair Clamp



THE S. R. Dresser Manufacturing Co., Bradford, Pa., has recently announced a new bell and spigot repair clamp known as style 4½ H. P.

In this clamp a gasket of reverse wedge-shape overlaps the caulking and insures a perfect seal whether the joint is straight or extremely out of alignment. The clamp ring confines the gasket and regulates its compression.

The manufacturer claims that sufficient flexibility is provided by the resiliency of the gasket to permit considerable movement without impairment of the utility of the clamp. The clamp is simple in design, light in weight, and has adequate strength at all points of stress.

A descriptive folder is available from the manufacturer.

Neilan Recording Temperature or Pressure Controller

NEILAN CO., LTD., Los Angeles, manufacturers of automatic control and regulating devices, are now marketing a line of tested instrument type recording controllers for temperature, pressure and flow. These Neilan Instruments are built on a new principle, which gives them straight line function. The makers claim new and improved methods of easy adjustment for all types of process control. Definite increments of movement of the control element produces uniform increments of movement of the diaphragm motor valve.

Descriptive literature may be obtained from the Neilan Co., Ltd., 651 Santa Fe Avenue, Los Angeles, Calif.

These facilities mean FINE WORK—FAST DELIVERY

THE Limbert pipe bending shop, with abundant capacity, makes prompt delivery certain. But more than mere bigness, this unusual plant incorporates the most highly developed methods for accurate quality work. The equipment and methods used here are the result of a full third of a century of pipe fabricating experience.

In this shop your most difficult job will be handled skillfully and promptly. The experienced engineers who design the material, and the mechanics who man the shop, know exactly what they are doing. Limbert facilities include the most modern specialized equipment for every phase of pipe and fitting fabrication in steel, iron, or welded construction. Every type of high pressure, high temperature pipe joint can be produced promptly.

LIMBERT PIPING

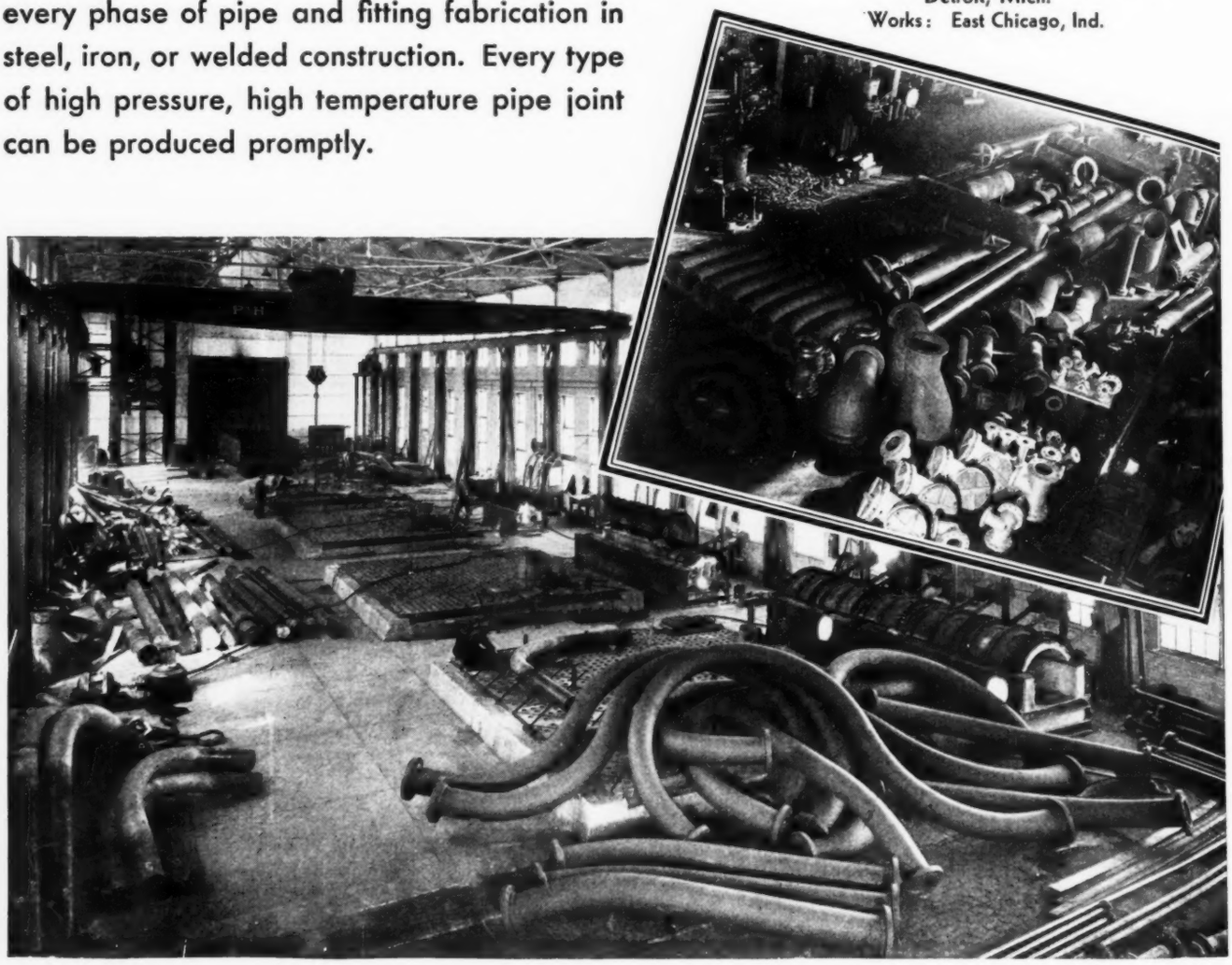
GEO. B. LIMBERT & CO.

570 Fulton St., Chicago, Ill.

St. Louis, Mo. Kansas City, Mo.

Detroit, Mich.

Works: East Chicago, Ind.

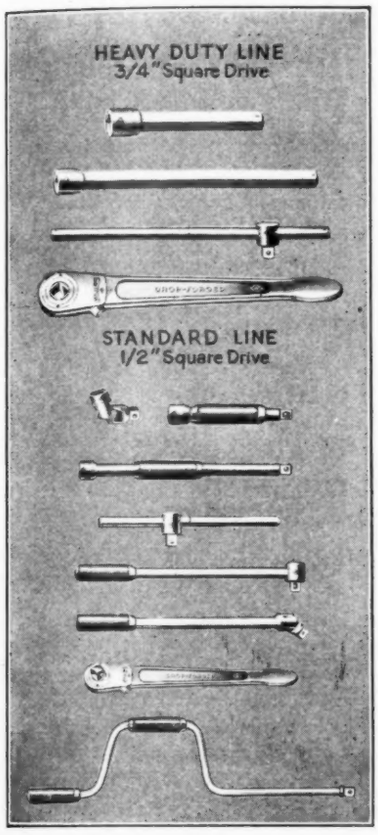


When writing GEO. B. LIMBERT & CO., *please mention The Petroleum Engineer*

Williams' Socket Wrenches

Above: Extra Heavy Duty line (1" Hex Drive) assembled in SET No. 75

Below: Handles and parts for Heavy Duty and Standard lines.



Cut No. 1

J. H. Williams wrenches.

Cut No. 2

Cut No. 3

Cut No. 4

J. H. WILLIAMS & Co., Buffalo, N. Y., have announced a new and complete line of detachable socket wrenches for industrial service that provides complete equipment for every variety of work. Three separate and distinct patterns of sockets with a full assortment of handles and parts for each are included.

For the convenience of users, Williams' socket wrenches are available in careful selections of the popular sizes of sockets combined with the necessary handles and parts. These are assembled and furnished in convenient steel box provided with trays, or compartments.

All Williams sockets, handles and accessories are chrome-plated over nickel and are guaranteed against breakage. Literature will be supplied by the manufacturers on request.

Cut No. 1 shows, above: Extra heavy-duty line (one-inch hex drive) assembled in set No. 75. Below: Handles and parts for heavy-duty and standard lines.

Cut No. 2 is the standard pattern with one-half-inch square drive, which includes sockets with double-hex, hex and square openings up to one inch.

The heavy-duty pattern, illustrated in cut No. 3, has three-quarter-inch square drive and is provided with sockets with double-hex openings 7/8-inch to 1 1/8-inch. This line is designed for harder service than usual in the ordinary run of work.

The extra heavy-duty has a one-inch hex drive and sockets with double-hex openings 1 7/8-inch to 2 3/8-inch is shown in Cut No. 4. This pattern is designed for the hardest and heaviest service.

American Tie-Down Companion Flange

AMERICAN IRON & MACHINE WORKS, Oklahoma City, has developed and placed on the market the American tie-down companion flange, designed for use with both screw and flange type gate valves. It is grooved according to the packing ring or gasket, depending upon the make of the gate valve.

The flange is constructed from a one-piece cast steel, and designed to withstand high pressures. Both bolts and stirrups may be used because of its ears. The makers

claim it is not necessary to relieve the hold-down bolts on the gate valves when it is desired to remove the connections down to the companion flange.

Further details of this new piece of equipment may be secured by requesting information from the American Iron & Machine Works.

Baash-Ross Roller Bearing Traveling Blocks

THE Baash-Ross Roller Bearing Traveling Block offers balance for smooth, fast running with safety through its taper construction, according to the makers. It is compact and rigidly designed to prolong the life of the sheaves, and consequently the lines.

Each sheave is mounted and rotates on its own individual roller bearing, which turns on a hardened and ground inner race. This race is keyed to a one-piece center pin of high grade steel. On one end it is solid and has a heavy shoulder; the other end is threaded for the hexagonal retaining nut. The solid end of the pin is drilled for individual lubrication to each roller bearing, and is facilitated by the use of Alemite connections recessed in the end of the main pin.

The main center pin is thoroughly braced and supported by means of half-inch steel spacer plates between each sheave, by two one-inch outer plates and by two solid steel upper and lower end pins. In order to be easily removed, the two end pins are also made with a shoulder at one end and a hexagonal nut at the other.

Full description and mechanical features of this traveling block may be secured by writing to the Baash-Ross Company at Los Angeles, or from any of its distributors.

The Key to Perfect Oil Well Control—

KEROTEST

Flow Line Valves and Fittings

—kerosene tested and certified to withstand 6,000 pounds hydrostatic pressure . . . available in all sizes, 2-inch to 6-inch inclusive, with either screwed or flanged ends.

For 100 per cent performance make your flow lines 100 per cent KEROTEST.

Also available in

1000 lb. Test
1500 lb. Test
2000 lb. Test
3000 lb. Test
6000 lb. Test

Kerotest Manufacturing Company

Pittsburgh, Penna.

See our exhibit at the 2nd Annual Oil Equipment and Engineering Exposition, Los Angeles, March 16 to 22, 1931.

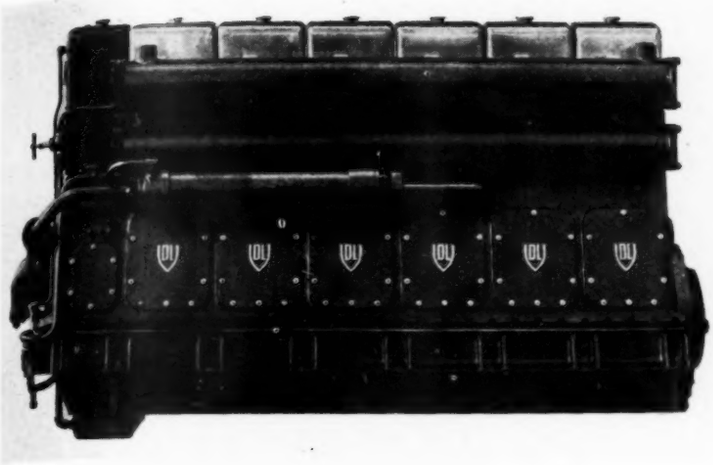
Carried in Stock and Sold By

Oil Well Supply Company, Branch Stores and Offices throughout the World

Norvell-Wilder Supply Company, Houston, Beaumont, Shreveport, Fort Worth

When writing KEROTEST MFG. CO., *please mention The Petroleum Engineer*

The De La Vergne High Speed Diesel



THE new De La Vergne high speed Diesel, manufactured by I. P. Morris & De La Vergne, Inc., Philadelphia, Pa., is designed and constructed for 750 revolutions per minute with all the quality necessary to make such high speed conservative and reliable.

According to the makers, it can be adapted to any kind of service; bedplates, power take-offs, reverse gears, flywheels, clutches and radiator cooling can be provided as required.

The engine can be run at any constant speed from 300 revolutions per minute up to the rated speed of 750 r. p. m. It is built in three to eight-cylinder units with a rating of 50 horsepower per cylinder at 750 r. p. m.

Full details and specifications of this new engine will gladly be sent to those interested, upon application to the manufacturers.

Cardwell Allsteel Automatic-Release Pipe Tongs

THE Allsteel Products Manufacturing Company of Wichita, Kansas, announces the new Cardwell Allsteel automatic-release pipe tongs, which automatically releases the load when tension on lifting line is lowered.

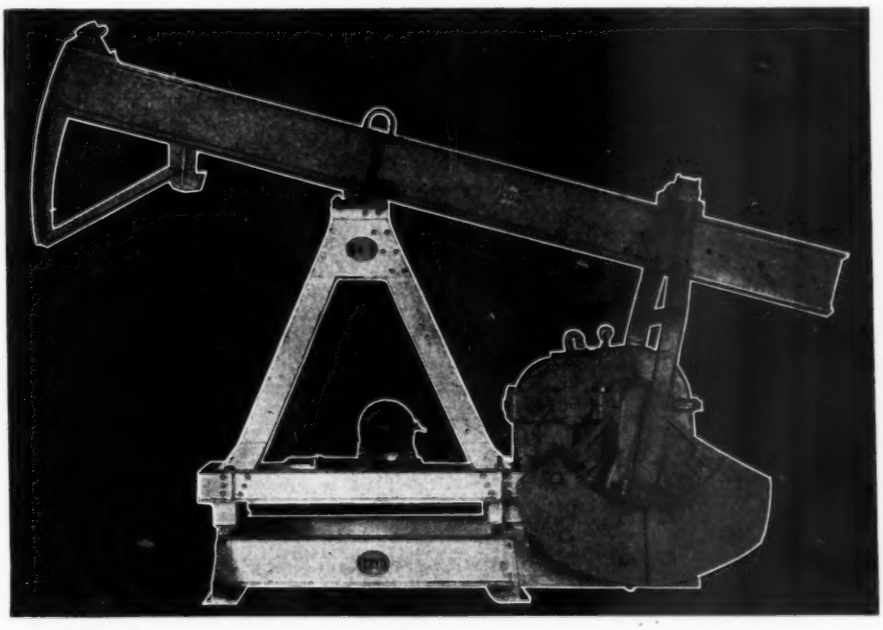
The manufacturer states that the tongs are so constructed that the "palms" of the gripping surfaces take hold positively and do not slip as they "bite." The gripping surfaces are of large, rectangular palms with positive grip, with great strength due to all-steel construction.

The overall dimensions are the same in either open or closed positions, enabling them to be dropped into the pipe trench to lift the pipe out without "bell-holing" the ditch walls, or digging under the pipe.

The operation of the automatic release feature is accomplished by releasing the tension from the lifting line causing the ring to fall and to be rotated at the same time by the weight of the tripping handle until the spur on the ring engages the hook. When tension is applied to the lifting line the tongs are lifted by the hook instead of by the links which operate the gripping surfaces and the tongs come free from the load.

The Ideco Type A-3 Pumping Unit

THE Ideco Type A-3 pumping unit, designed for use with gas or electric drive, is the latest Ideco development in pumping and drilling machinery. It is a double reduction gear unit with double Helical (herringbone type) continuous tooth gears, drive by a motor or single or multicylinder gas engine through "V" belt or silent chain drive; a crankshaft with twin 42-inch cranks . . . one on either side of the gear housing; and Ideco crank counterbalance for each crank; a double pitman; heavy duty roller pitman bearings; and "A" Frame Samson post; a solid I beam type walking beam; and a mule head for straight lift pumping. All driving gears are completely enclosed and operate continuously in a bath of oil.

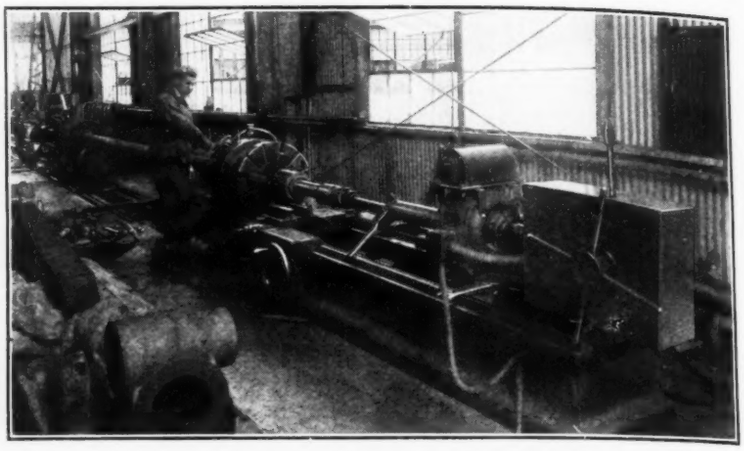


The entire assembly is mounted as a unit upon a structural steel bed plate, and is built for installation upon the derrick floor or for mounting upon a concrete foundation. The unit is complete in itself, and with exception of the motor or engine requires no additional equipment.

For further information write the International Derrick & Equipment Company, Columbus, Ohio.

Special Boring Process for Drill Collars

Testing drill collars and stems for size.



Set-up of special machine constructed by the Baash-Ross Tool Company for drilling water courses straight and accurate enough to pass the "Bar Test" through drill collars and drill stems up to 53 feet in length.

TO GUARD against the delivery of drill collars or stems that might have some weakness due to removal of too much metal in the boring process, all Baash-Ross tools of this class are now tested by passing entirely through them a straight, stiff rod which has a clearance of only one-quarter inch on the water course diameter in the smaller sizes, and three-eighths inch in the larger, up to 8⅝-inch diameter.

It has been necessary to build a special machine, after considerable experiment, to insure drilling these long forgings straight and centered with sufficient accuracy to pass the Baash-Ross test.

This machine, constructed by the Baash-Ross Tool Company especially for the purpose, carries the drill on a steel mandrel of a diameter which nearly fills the bored hole. Fluid is circulated around the mandrel, at 125 pounds pressure, for lubricating and cooling the drill, and carrying the chips away through a water course inside the mandrel.

The drill is stationary, the work revolving around it. The added stiffness imparted by the maximum diameter of the mandrel, and the fluid pressure which fills the small space between it and the hole, greatly reduces the tendency of the drill to vary its course.

The OCT Pressure Relief Plug

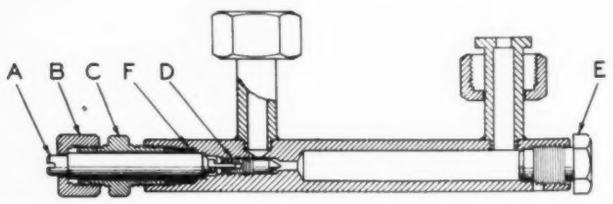
OIL CENTER TOOL COMPANY, INC., 924 Adelle Street, Houston, Texas, announces the development and production of the OCT Pressure Relief Plug for use on slush pump discharge lines. Fitted with a simple plate, designed to break and relieve pressure at any desired point, the plug insures against blowing out pump water-ends, rotary hose or connections, or pump manifold connections, according to the manufacturer.

The OCT Pressure Relief Plug can be screwed into the discharge line at any point, or on the stand-pipe. Plates desired to break at any given pressure are furnished by the manufacturer, who suggests that the breaking point be 200 to 250 pounds lower than the test pressure of the manifold fittings and rotary hose.

OCT Pressure Relief Plugs are furnished in three-inch size, which may be employed on any size line by the use of swaged bushings.

The Foxboro Company's Damping U-Tube

A NEW Damping U-Tube has been perfected recently by the Foxboro Company, Foxboro, Mass., for use on all its new style Flow Meters and Flow Controllers. This U-Tube can be adjusted for proper damping while the instrument is in operation. There is no need of shut-



ting the pressure off or taking the instrument apart in order to make this adjustment.

The new Damping U-Tube is not furnished as standard equipment but must be specified when ordering a new Flow Meter or Flow Controller. It may be ordered for installation on all Foxboro Flow Meters or Flow Controllers now in the field except types T, C, A and B.

PERFECTION

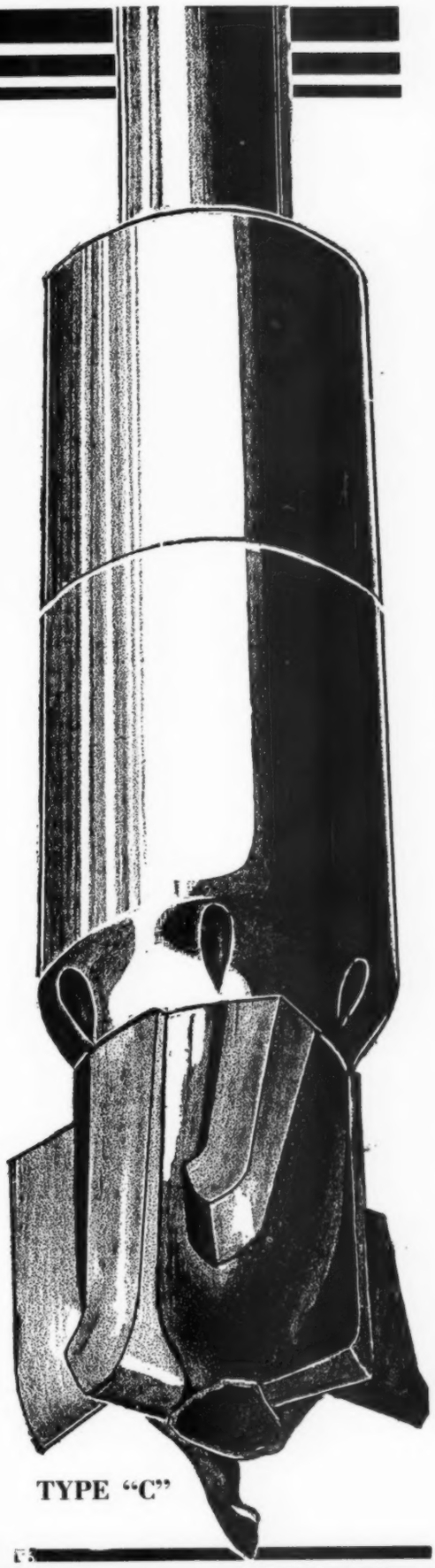
In a core barrel, this word could only apply to a tool that had revolutionized the taking of cores.

Ask any contractor who has used it, if the Perfection core barrel has the right name.

The new Type M cools the bit effectively by putting circulation right on the cutting edge. Type C Perfection Core Barrels can be converted by replacing with Type M Bit Body and Cutter head which are furnished without extra cost.

TYPE "M" Bit Body

TYPE "M" Cutter Head



TYPE "C"

The Brewster COMPANY~INC.
Shreveport,Louisiana

BUY FROM YOUR SUPPLY HOUSE

Complete Stock carried at these Warehouses: Red Ball, Inc., 2-4 East California St., Oklahoma City, phone W-3680; The Iverson Specialty Co., Oklahoma City; Houston store, 2000 Harrington St., phone Capitol 3021. Exclusive Export Agents: W-K-M Co., 74 Trinity Place, New York, N. Y.

R. C. Holmes.

R. C. Holmes, president of The Texas Corporation, has been elected president of Indian Refining Company. The Texas Company recently took over the Indian Refining Company through an exchange of stock. P. C. Scullin, formerly assistant manager of the refinery department of The Texas Company, was elected vice-president and general manager of the Indian Refining Company.

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C. E. Beecher, chief production engineer, with the Empire Companies, Bartlesville, Oklahoma, has been elected chairman of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers.

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W. J. Crites, superintendent water department, Phillips Petroleum Company, has moved from Whittenburg, Texas, to 707 N. W. 29th Street, Oklahoma City.

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L. M. Hammel, formerly toolpusher for the Johnson-Kremmitz Drilling Company, is now superintendent for the Government Petroleum Corporation.

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Wallace L. Hancock has been elected a member of the Board of Directors of the Trimont Manufacturing Company. Mr. Hancock has had over twenty years' association with the Trimont Manufacturing Company and at the present time is treasurer.

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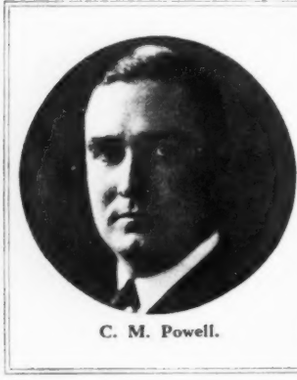
C. M. Powell has been made district manager of the International Derrick & Equipment Company, with headquarters in Tulsa.


C. M. Powell.

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H. E. Spear, formerly with The Texas Company, at Houston, Texas, is now assistant superintendent of the automotive department for Shell Petroleum Corporation. Mr. Spears is now located at St. Louis, Mo.

C. E. Beecher.

T. B. Leech has joined Alco Products, Incorporated, as sales representative in the Tulsa district. Alco Products, Incorporated, is a division of the American Locomotive Company, offering complete service and equipment to the oil refining industry. Mr. Leech was previously with the Southwestern Engineering Company.

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T. B. Leech.

E. L. Varney, construction engineer for the C. F. Braun & Co., Inc., left San Francisco recently on the steamship President Lincoln for Burma. Here he will supervise the installation of two Braun-constructed recovery plants in the oil fields near Mandalay, which will be the first two Braun recovery plants established in the oil fields of this part of Asia.

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Glenn Moore, foreman, Sinclair Oil & Gas Company, has been moved from Shidler, Okla., to Maud, Okla.

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Leif Olson, toolpusher, Olson Drilling Company, has been transferred to Hobbs, New Mexico. He was formerly in the Oklahoma City field.

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Paul D. Torrey of Torrey, Fralich and Simmons, petroleum engineering firm, of Bradford, Pa., gave a radio talk on "The Natural Gas Industry of New York State," over Station WKBW of the Columbia Broadcasting System on the evening of March 1, 1931.

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Glenn Harroun, superintendent of field operations for the Sinclair Oil & Gas Company, has had his territory enlarged to include that of East Texas, where his company is developing large holdings. His Texas headquarters will be in Ft. Worth. Mr. Harroun has been in charge of the Sinclair development program at Oklahoma City. He covers his large Oklahoma and, now, Texas area by the use of an airplane.

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G. E. Freeman, engineer, The Texas Company, has been transferred from Vivian to Houma, La.

Glenn Harroun.

F. F. Fenzi, consulting engineer, formerly of Santa Barbara, Calif., is now located at 11 Via T. Bertelli, Florence, Italy.

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S. C. Miller, petroleum engineer, Continental Oil Company, has been transferred from Wichita Falls, Texas, to Denver, Colo.

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H. P. Parrigin, refinery superintendent, The Texas Company, has been transferred from the Dallas plant to Port Arthur, Texas.

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B. W. ("Bart") Gillespie was recently appointed manager of the export department of the Elliott Core Drilling Company, Los Angeles, Calif., succeeding H. A. Kassebaum, resigned. E. A. Spencer has been made superintendent of California service for Elliott Core Drilling Company.

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Frank C. Gignoux was named chief engineer of the Reed Roller Bit Company, effective January 1. He is now located at the plant and main office in Houston, Texas. Mr. Gignoux graduated from the University of Nevada, School of Mechanical Engineering, in 1913. During the years 1913 and 1914 he was with the General Electric Company, New York, as test engineer. He was superintendent of mechanical operations of the Coalition Mining Company, Nevada, from 1915 to 1918, at which time he became connected with the U. S. air service, department of airplane construction. He served the Shell company in various fields of California and Venezuela, S. A., as field and construction engineer from 1919 to 1928, at which time he became associated with the Reed Roller Bit Company, Los Angeles, as engineer and assistant branch manager, a position he held until promoted to his present office.

Frank C. Gignoux.

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E. B. Haas, toolpusher, Humble Oil & Refining Company, Breckenridge, Texas, has been transferred to Uvalde, Texas.

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C. C. Farris, drilling superintendent, Golding & Cochran, has been transferred from Electra, Texas, to Olney, Texas.

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R. E. Lege.

R. E. Lege is now chief chemist at the Gulf States Corp. refinery at Oklahoma City. He was formerly with the White Oak Refining Co. at Allen, Okla.

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J. E. Smallwood is district foreman in the Wichita Falls, Texas, district for the Northern Texas Utilities Company. He was previously with the Houston Gulf Gas Company.

Fred H. Hayes, formerly vice-president of Prescott Pump Company, Menominee, Mich., is now associated with Goulds Pumps, Inc., Seneca Falls, N. Y. Mr. Hayes, who has had wide experience in pipe line pumping work, is manager of the pipe line pump department, and is working through Goulds' present branch office organization.

Fred H. Hayes.

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R. E. Whiting, district superintendent, Atlantic Oil Producing Company, has been transferred from Seminole, Okla., to Wink, Texas.

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Lew D. Hilton, well-known field engineer for Cameron Iron Works, Houston, Texas, is calling on the trade in the Tulsa district. He is greatly enjoying calling upon many old acquaintances and friends.

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Shep Meyers and Lyle Brush, representatives of the Kerotest Manufacturing Company, are in East Texas in the interest of their company.

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Walter Swaney, general manager of the Kerotest Mfg. Co., Pittsburgh, Pa., has returned home from a visit in the Mid-Continent and Gulf Coast oil fields.

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P. J. Sines, previously superintendent for M. J. Delaney, drilling contractor, at Amarillo, Texas, is now with the Alma Drilling Company at Hobbs, New Mexico.

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R. G. Gofner, general foreman, Humble Pipe Line Company, Houston, Texas, is now located at Longview, Texas.

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Dr. M. E. Touwaide, petroleum engineer, The Bataafsche Petroleum Company, has moved from Iarakan, Dutch East Indies, to Fez, V. N., Morocco.

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H. A. Sanders, farm boss, Sun Oil Company, at Mirando City, Texas, has been transferred to Woodsboro, Texas.

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K. K. Kramer, production engineer, Sinclair Oil & Gas Company, Houston, Texas, has been promoted to chief engineer.

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Frank McCarthy, formerly general manager Unita Pipe Line Company, Salt Lake City, Utah, is now chief engineer for the Ohio Oil Company at Findlay, Ohio.

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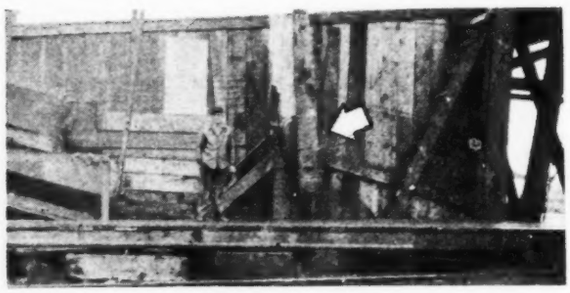
Leslie S. Moore has been transferred from the Port Arthur plant of the Gulf Refining Company to the company's Philadelphia plant.

At the Greenwich, Kansas Proving Ground

JONES *high manganese* FULLY NORMALIZED SUCKER RODS

dominate the field

In this region, where hundreds of barrels of water must be pumped daily to get a profitable oil production, sucker rods are naturally subjected to the most gruelling strain of day and night operation. Here it is that Jones H. M. Fully Normalized Sucker Rods excel! Their wonderful performance record has resulted in their exclusive use on most of the wells in this difficult district. Here is a typical Jones service record in this district. The well was 2900 feet deep, from which was pumped 150 barrels of oil and 700 barrels of water daily. A string of 7/8-inch Jones High Manganese Fully Normalized Sucker Rods lifted this load continuously for 360 days at an average of 25 revolutions per minute, then ran 36 more days at 16 r.p.m., or a total of 13,789,000 lifts! The estimated weight of fluid lifted has been 75,000,000 pounds. Through it all there has been but 4 failures. This kind of Jones Sucker Rod service speaks for itself.



THE S. M. JONES CO.
TOLEDO, OHIO

Mid-Continent Office: McBirney Building, Tulsa, Okla.
Export Distributors: The Parkersburg Rig & Reel Co., 25 Broadway, Room 736, New York, N. Y.

When writing S. M. Jones Co., *please mention The Petroleum Engineer*

Couplings Are Specially Coated On Panhandle Eastern Line

As more and more attention is given to the proper application of protective coatings to pipe, it follows that more careful and studied consideration is given to the painting of couplings. Corrosion at the joints has in most instances been traced to faulty application of the protective material. Consequently former methods of daubing and brushing couplings are giving way to methods which not only eliminate a great amount of waste but, at the same time, give a more uniform and thorough covering to the most inaccessible parts of a coupling.

To accomplish this end the Panhandle Eastern Pipe Line Company's 22-inch line under construction through Missouri is being coated under rigid inspection and particular attention is given to the coating of couplings. A light weight metal apron, fastened to the bottom half of the coupling, is used in connection with the painting. With this piece of equipment in place a quick-drying hot application is poured and splashed over the top part of the coupling and spreads to the most inaccessible parts. Little of the material is wasted because the excess paint runs down into the apron where it is trapped. When the temperature of the material in the apron has dropped, the paint is drained out into a bucket hanging beneath the spigot. The bottom half of the coupling will then have been given a satisfactory covering.

The apron is of welded construction and made with sheet metal. It is wide enough to permit it easily to slip over the bolts of the coupling and permit paint to cover the sections of the pipe left bare for the coupling and not entirely covered by the coupling ring. Its circumstance is slightly greater than half of the circumference of the pipe. Chains are fastened to either side of each end of the apron and these are long enough to reach over the top of the pipe and be hooked together.

When slipped over the coupling the slack of the chain is taken up and a mope pole slipped under the chains. Two men on the opposite end of the pole bear down on it and, in this manner, the apron is pulled flush to the pipe so that none of the hot paint will escape.

A bucket is fastened to a hook on the drain in the bottom of the apron and the drain closed. One of the crew starts pouring the application on the top and sides of the coupling, splashing some of it so it will reach all parts. Paint is poured on all of the coupling not covered by the apron. Much of this material drains into the apron.

The pipe going into this line is mill-primed and given a hot enamel coating over a cold field applied priming coat. The hot enamel is heated to about 475 degrees before application and is applied by spreading as the pipe is rotated on a rolling rig.

In order to take care of expansion and contraction the material used in coating the couplings is a more elastic paint than the ordinary enamel. Eight men comprise the coupling paint gang and one kerosene-heated field pot is used. It requires almost two gallons of material to paint one coupling.

Top to bottom—Close-up of apron in place. Draining paint from apron to bucket. Crew riding mope pole to tighten apron before pouring paint.

Edited by **BARNEY HORRIGAN**

The prize wise crack of the month goes to Bob MacDonald of the Deep Rock Oil Corp., who was present at the recent Tulsa, Okla., meeting of the A. I. M. E.

At the meeting, C. P. Parsons, of the Halliburton Co., and T. H. Rakestraw of the Gypsy Oil Co., delivered a paper on well cementing. Commenting on the paper, Bob asked Mr. Parsons how long the paper was, and was told 12,000 words. "If I were paid at the same rate as Calvin Coolidge, there would be real money in writing," said Mr. Parsons. "You ought to get more," said Bob, "your remarks are more CONCRETE."

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Barney met John Larkin, veteran oil producer, and Grand Old Man of the petroleum industry in Tulsa on the street the other day and asked him what time it was.

"Don't know. I left my watch at home," said Larkin.

"I suppose you'll pull that one on me about it running down," said Barney.

"No chance of that," replied Larkin "there's a winding staircase in our house."

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And then there was the Scotchman who was so close he got slapped.

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Barney Says—

Emerson's old philosophy about the best mousetrap and the beaten path to one's door will not stand up in face of modern competition. You must go out and sell your mousetraps and demonstrate with live mice.

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The World's Meanest Man

—has been discovered again! His wife who had just witnessed the much ballyhooed gorilla picture "Ingagi" was describing it to him.

"Just think," said she, "one scene showed a big baboon carrying a woman off into the jungle."

"Well," drawled the World's Meanest Man, "he was only a monkey and didn't know any better."

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So, Over He Went

An Englishman on a visit to the West decided to go horseback riding. The hostler who was to attend him asked, "Do you prefer an English saddle or a Western?"

"What's the difference?" he asked.

"The Western saddle has a horn," replied the attendant.

"I don't think I'll need the horn," said the Englishman. I don't intend to ride in heavy traffic."

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"Are you hiding from police?"

"No, I can walk right into any speakeasy in town."

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Nine, Ten and Out!

Archie (reading joke)—"Fancy this, Percy, a chap here thinks that a football coach has four wheels."

Percy—"Haw, Haw! And how many wheels has the bally thing?"

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They call her "Checkers" because she always jumps when you make a bad move.—Minn. Ski-U-Mah.

ꝺ ꝺ ꝺ ꝺ

Then there was the prohibition agent who refused to take a drink because he was off duty.

ꝺ ꝺ ꝺ ꝺ

She was only a printer's daughter, but she had a bold face.
—Minn. Ski-U-Mah.

ꝺ ꝺ ꝺ ꝺ

She was only a carpenter's daughter, but she bore me no mallets.
Black & Blue Jay.

ꝺ ꝺ ꝺ ꝺ

When better cars are built, fathers will go to work on about the same grade of shoes.

ꝺ ꝺ ꝺ ꝺ

They laughed when I said I could crack a joke, but they stopped when I cracked it.—Penn. Punch Bowl.

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Maid: There's a woman outside with a man.

Old Maid: Tell her I'll take him.

ꝺ ꝺ ꝺ ꝺ

And then of course there's the musical carpenter. He plays on the tuba four.—Wisconsin Octopus.

The Buy Now campaign has extended to Chicago where they are saying, "Buy now and put more prohibition agents to work."

ꝺ ꝺ ꝺ ꝺ

Henrietta: Honey, are you thinking of me?

Bored Boy: Oh, was I laughing? I'm sorry, pardon me.
Ohio State Sun Dial.

ꝺ ꝺ ꝺ ꝺ

Coupla Sizes Larger, Please

After buying a Louis XIV bed, Mr. Johnston came to the conclusion it was too small; so he returned it, asking that they send him a Louis XVI.—From The Yellow Strand.

ꝺ ꝺ ꝺ ꝺ

B. Walker tells of the Scot's wife whose doctor told her she had to have salt air. . .She woke up next morning and her husband was fanning her with a herring.—Walter Winchell in the Daily Mirror.

ꝺ ꝺ ꝺ ꝺ

An old man fell for a Fountain of Youth advertisement. He was instructed to take six pills—one each day. Instead he took all six pills at once.

The next morning his family had difficulty in waking him up. Finally he did partly awaken and said—"I'll get up but I won't go to school."

ꝺ ꝺ ꝺ ꝺ

A Diplomat

The admiral, who was conducting an examination for the navy, was addressing one of the candidates.

"Who, in your opinion, are the three greatest sailors in British history?" he asked.

"I'm sorry, sir, I didn't catch your name when I entered the room," replied the student, "but the other two are Nelson and Drake."

ꝺ ꝺ ꝺ ꝺ

Good Morning to You

A firm of solicitors rang up a stock broker and the following conversation took place:

"Good morning. Are you Mr. Denman?"

"Yes. Who is that?"

"This is Mr. Huylet, Craftling, Studge, Minariddl, Gowle and Scarrow."

"Oh, good morning, good morning, good morning, good morning, good morning and good morning."

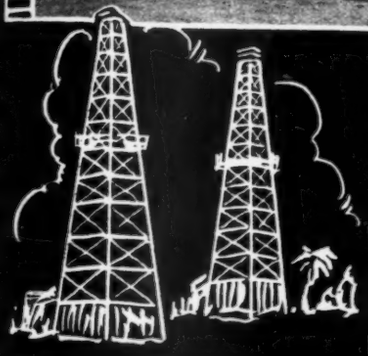
PICTORIAL PETROLEUM

MARCH • • • 1931 •

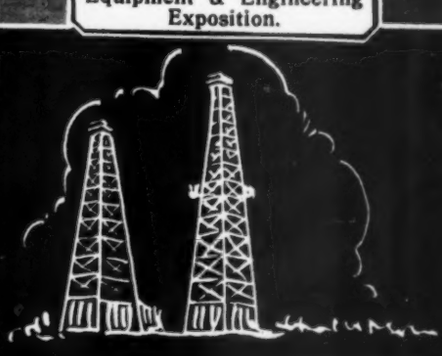
MONTHLY ROTOGRAVURE FEATURE OF THE PETROLEUM ENGINEER

This issue devoted to The Oil Equipment and Engineering Exposition Los Angeles March 16 to 22 and the California Petroleum Industry.

Main building of the Oil Equipment & Engineering Exposition.



E. G. Lenzner, managing director of the Oil Equipment & Engineering Exposition.



W. J. Blankenship, technical manager.

Lawrence Whitman, office manager.

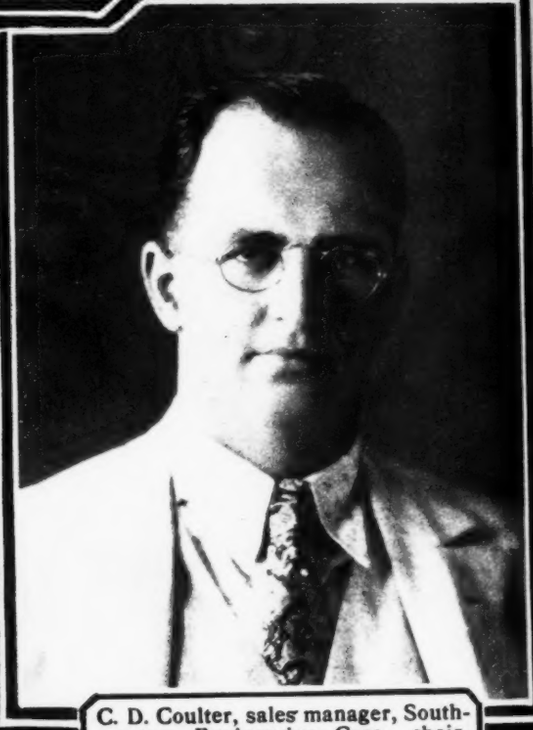
W. A. Sawdon, editorial and publicity manager.

Clyde Ellwood, sales manager, Axelson Manufacturing Co., Ltd., chairman producing equipment division.

Ted Sutter, general manager Baker Oil Tools, Inc., chairman of rotary hole equipment division.

On this and the page opposite are photographs of some of the heads of technical divisionsof the Oil Equipment & Engineering Exposition. Others, whose photographs do not appear, are C. B. Tibbitts of Los Angeles Steel Casting Co., chairman foundry division; A. B. Leonard, Haynes Stellite Co., chairman hard facing material division; C. J. Coberly, of Kobe, Inc., chairman tubular goods division; G. T. Brooke of Crane Company, chairman valves and fittings division; and J. C. Blake, district manager, Victor Welding Equipment Co., chairman welding equipment division.

C. Homer Spotts of McEverlast, Inc., chairman pipe coating division.

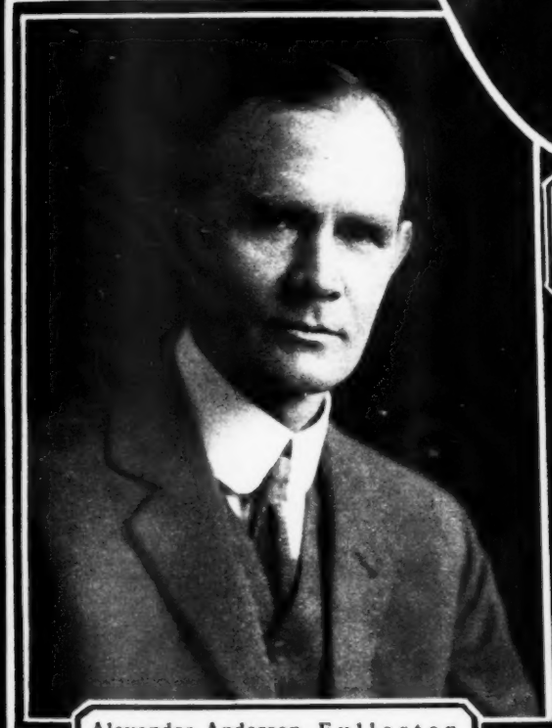


C. D. Coulter, sales manager, Southwestern Engineering Corp., chairman refinery equipment division.

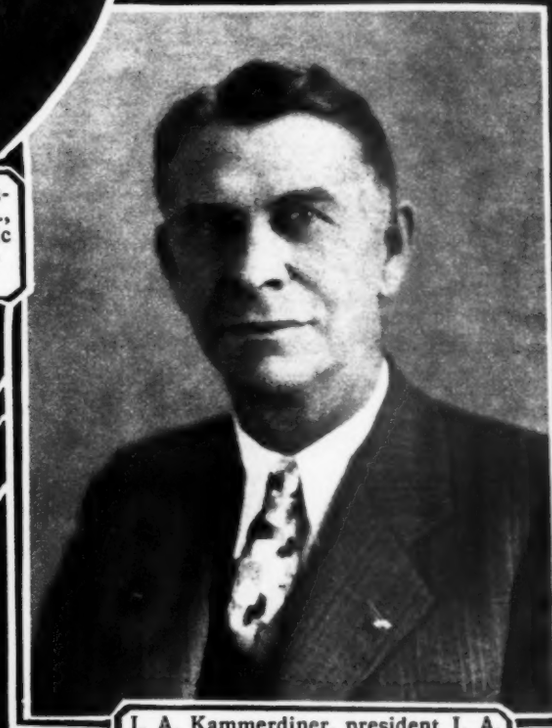
George L. Ratcliffe, president and general manager, California Talc Co., chairman rotary fluids division.

Frank R. Seaver, vice president and general manager, Doheny Stone Drill Co., chairman drilling equipment division.

H. C. Hill of General Electric Co., chairman electric equipment division.



Alexander Anderson, Fullerton, Calif., chairman instruments division.



J. A. Kammerdiner, president J. A. Kammerdiner Co., chairman fishing tools division.

Scenes in Los Angeles, f

Above—Looking south on Spring street from Sixth. Above, right—The new city hall. Photo by Padilla. Below, left—Hotel Biltmore, with Pershing Square in the foreground. Below, right—The Richfield Building at night.

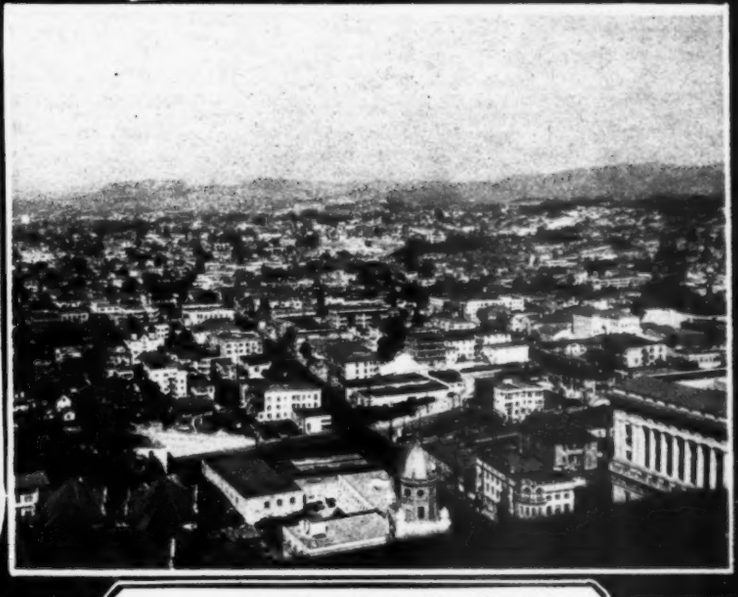
Host to the Exposition

The beautiful Wilshire Professional Building.

Looking down Broadway.

The Alexandria Hotel, popular with oil men.

The Texas Company Building.

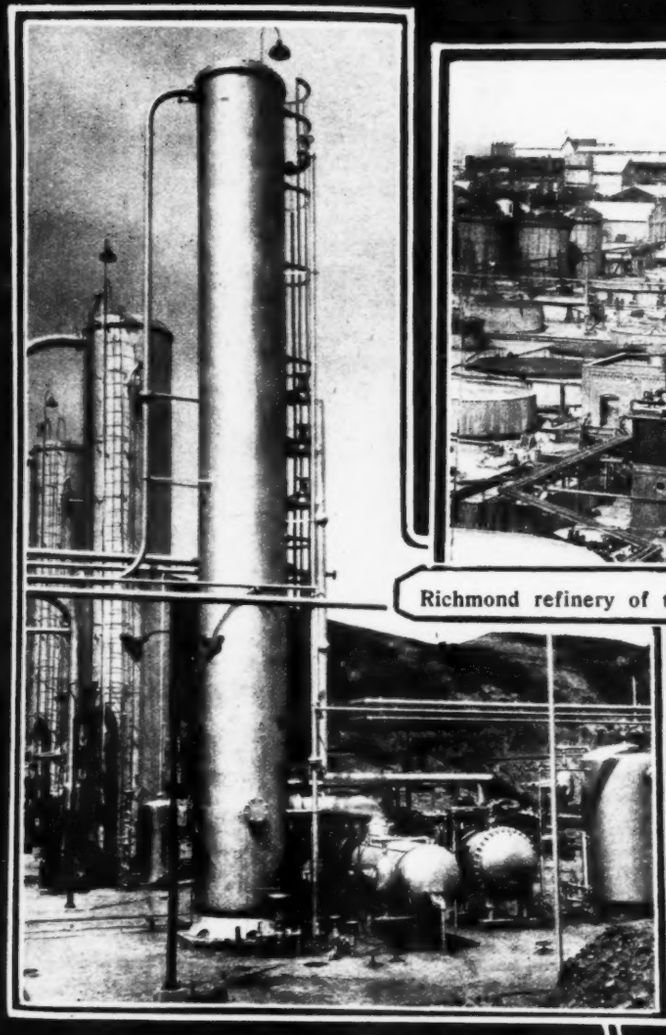


A section of Los Angeles, looking North from City Hall tower.

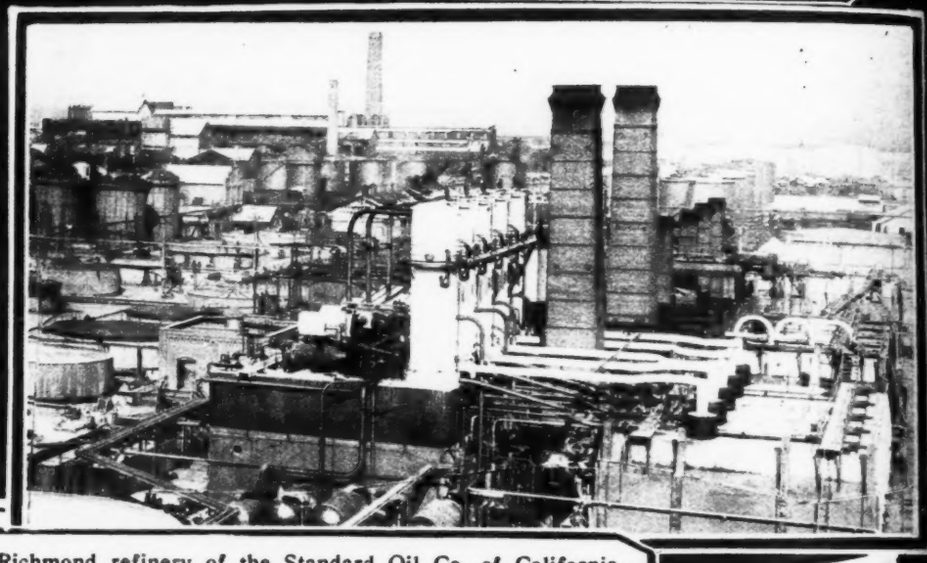
Ward B. Blodget, assistant manager Chanslor-Canfield Midway Oil Co. Photograph by Boye Studio.

Standard Oil Co. of California building in Los Angeles.

L. E. Lockhart, president, Rio Grande Oil Co. Photograph by Curtis Studio.



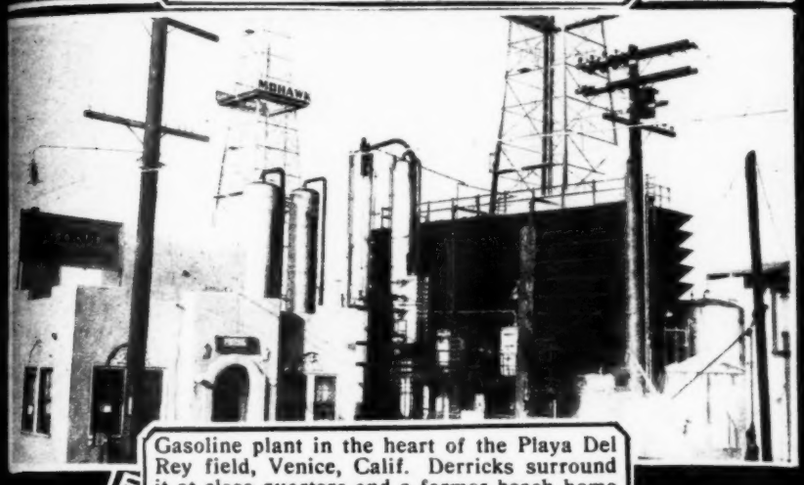
A natural gasoline plant in California.



Richmond refinery of the Standard Oil Co. of California.

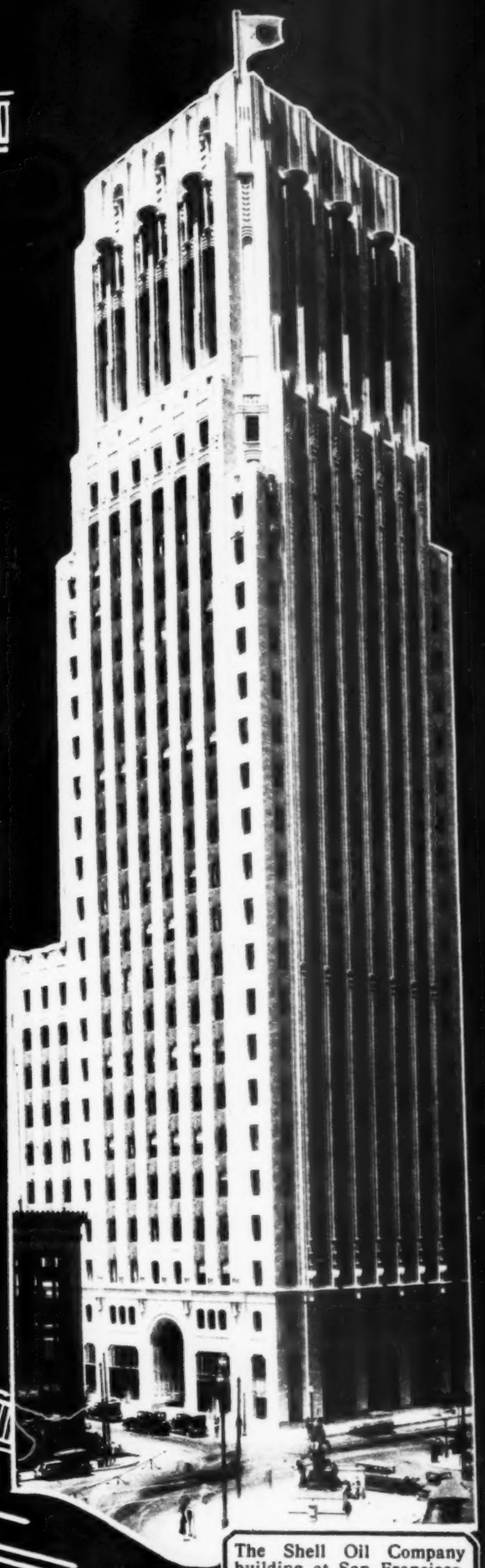
Brea Canyon in 1929.

E. Boaden of Societate Unirea, Ploesti, Roumania (left) and W. J. Blankenship, technical manager of the Oil Equipment & Engineering Exposition.



Gasoline plant in the heart of the Playa Del Rey field, Venice, Calif. Derricks surround it at close quarters and a former beach home serves as the company office.

On Southern California Gas Co.'s 22" line from Taft to Santa Monica terminal. The pipe in this picture was laid over an 80% grade.

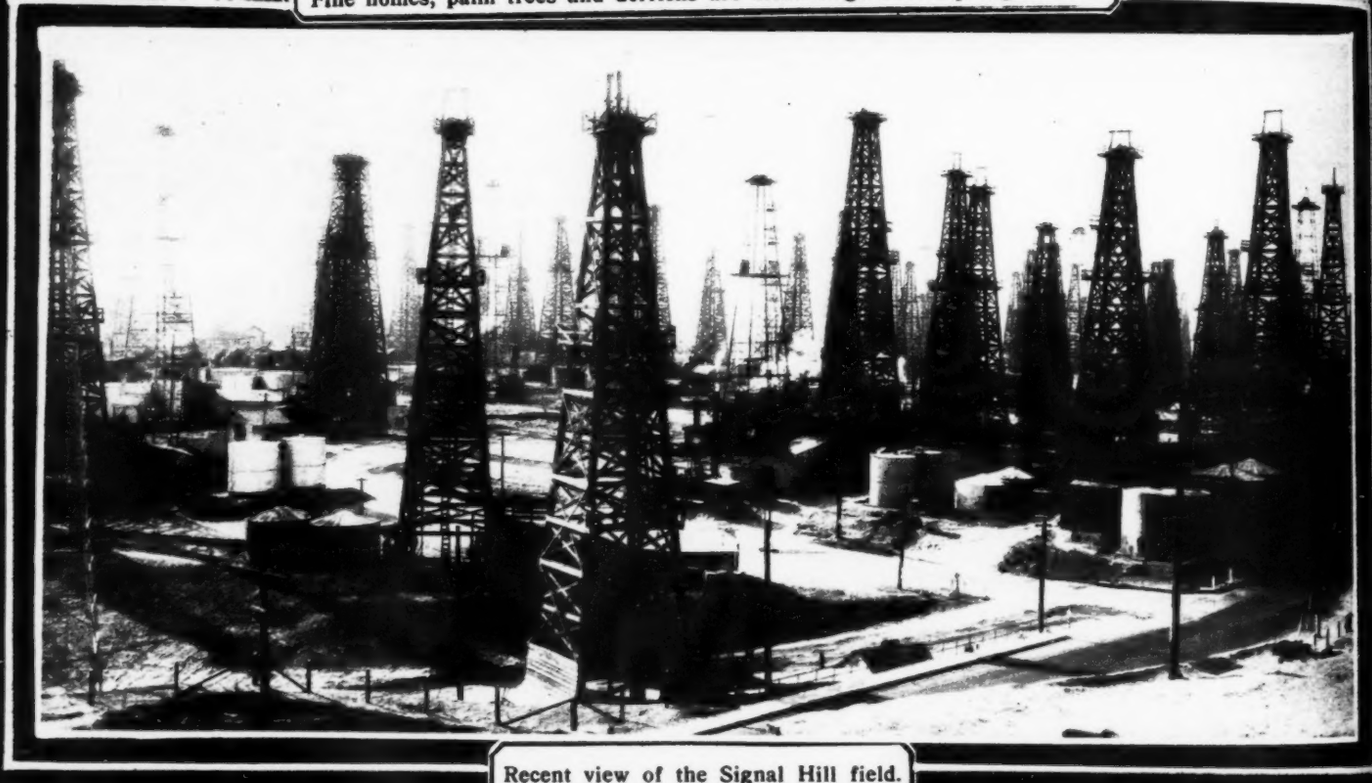


The Shell Oil Company building at San Francisco.

Associated Oil Co.'s mud classification plant in the Ventura field. Mud for all of this company's wells is prepared and reconditioned here.

A. H. Bell, general superintendent of production, California division of Continental Oil Co.

Fine homes, palm trees and derricks are close neighbors atop Signal Hill.

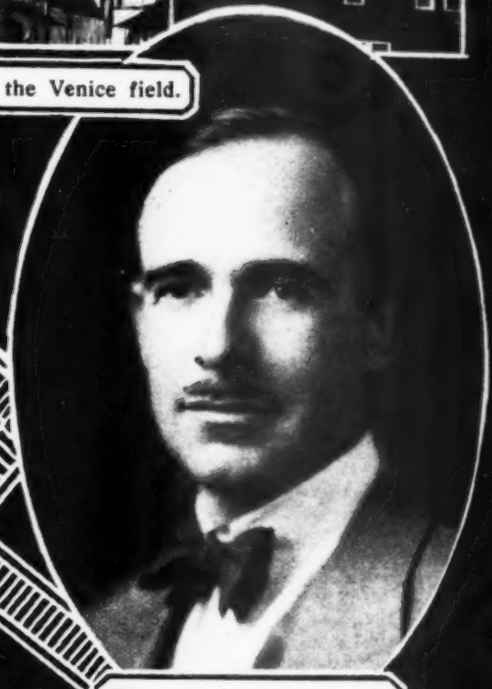


Recent view of the Signal Hill field.

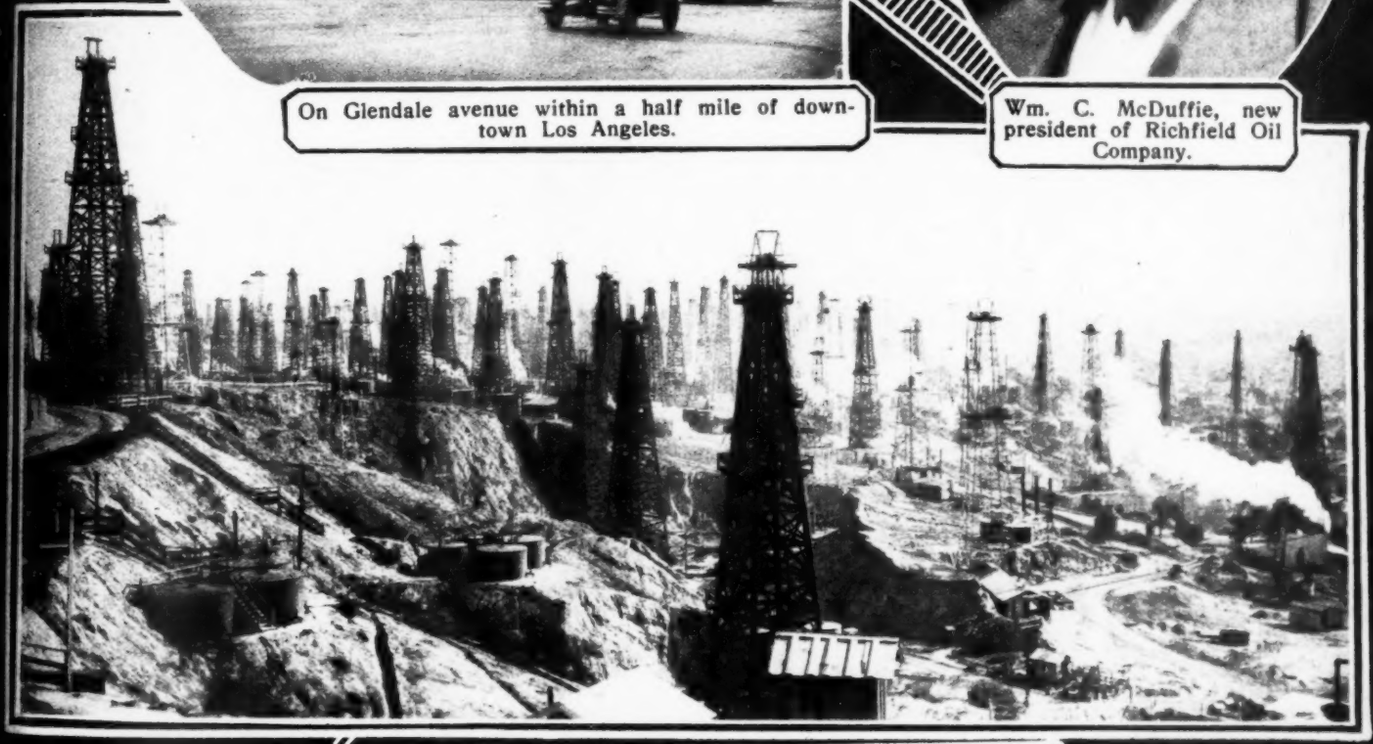
Carl E. Good, purchasing agent Barnsdall Oil Co. of California.

Line of wells along the ocean front in the Venice field.

On Glendale avenue within a half mile of downtown Los Angeles.



Wm. C. McDuffie, new president of Richfield Oil Company.



The present active drilling area on the southeast side of Signal Hill.

R. M. Barnes, in charge of petroleum engineering for the California division of Continental Oil Company.

A new Boeing biplane of Standard Oil Company of California. Oh, for the life of a pilot!

H. H. Jones, drilling superintendent, California division Continental Oil Co.

J. R. Gignoux, petroleum engineer, Shell Petroleum Corp., Los Angeles, Calif.

E. W. Masters, chief petroleum engineer, Shell Petroleum Corp., Los Angeles, Calif.

View illustrating close well spacing in Santa Fe Springs field.

Wm. Reinhardt, Shell Oil Company.

H. F. Landgraf, of Sarawak Oilfields, Ltd., Miri, Borneo, D. E. I. (left) and E. G. Lenzner general manager of the Oil Equipment & Engineering Exposition. This picture was taken while Mr. Landgraf was recently in America in the interests of his company.

R. E. Beckley, Standard Gasoline Co. of California.

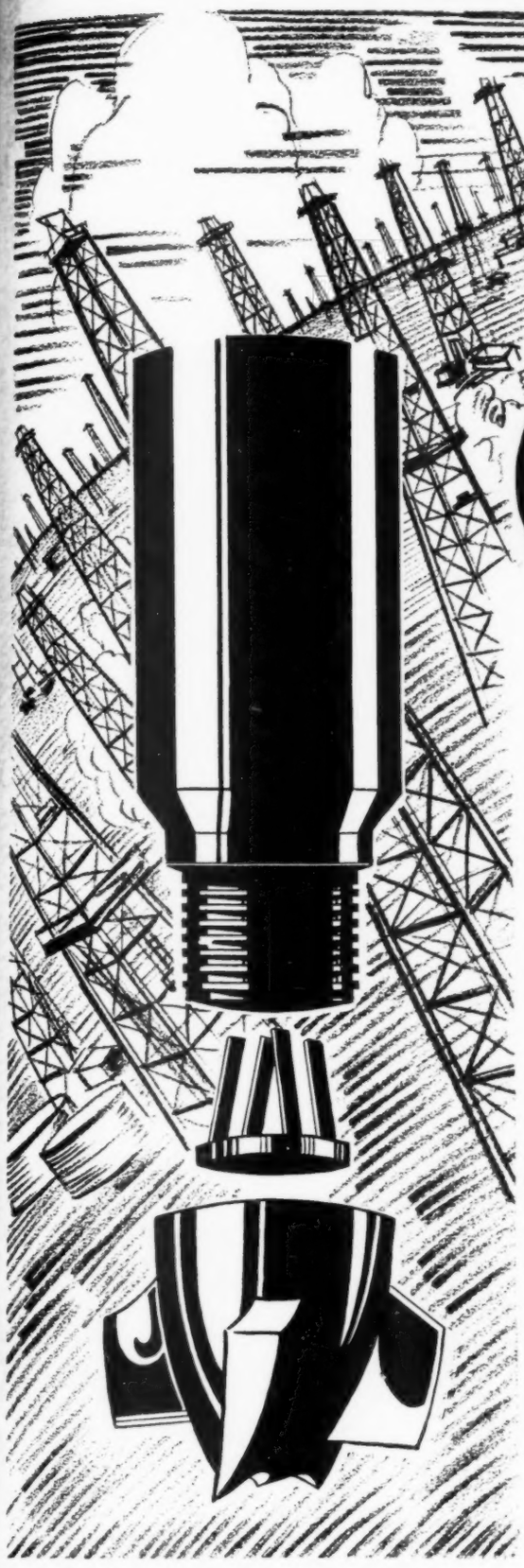
Compressor and gas lift station of Continental Oil Co. at Seal Beach.

Backfilling Otay pipe line on Harrison ranch near San Diego.

Milham discovery well at Kettleman Hills with elaborate trap installation in foreground for handling production of one well.

Neil Norris, manager of production for Mac Millan Petroleum Co. Photograph by Curtis Studio.

Richfield Oil Company Refinery, Lynwood, California



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The Vaporization *of* Petroleums *and* Pressure Distillates *

By GEORGE H. FANCHER †

This article contains results obtained in an investigation on "The Determination of the Physical Properties of Petroleums and Petroleum Products," listed as Project No. 13 of American Petroleum Research. Financial assistance in this work has been received from a research fund of the American Petroleum Institute donated by Mr. John D. Rockefeller. This fund is being administered by the Institute with the co-operation of the Central Petroleum Committee of the National Research Council.

THE importance of the method of formation of vapor from petroleum was shown by Leslie and Good[1] in their study of the vaporization of a light paraffin base petroleum. Ashworth[2] had arrived at the same conclusions independently in England. The results of these investigations pointed to the desirability of obtaining further information regarding equilibrium single-flash vaporization, since vaporization in a pipe still takes place under substantially equilibrium conditions. Many articles concerning the application of the process to industrial use have appeared in technical journals during the last few years yet actual data available are few.

Information regarding the equilibrium vaporization of petroleum less volatile than the usual paraffin-base crude was needed. Similar data concerning pressure distillates were desired also.

Two crude petroleums were available for the investigation, one representative of mixed-base Mid-Continental crudes, one typical of cyclic-base Californian crude. A pressure distillate from shell-type pressure stills and one from a pipe-still cracking plant using heavy fuel oil as the charging stock were obtained. These four materials were flash vaporized under equilibrium conditions and the properties of resulting distillates and residuums determined.

Equilibrium flash vaporization may be defined as that process of vapor formation in which all of the vapor and all of the residual liquid formed from the material heated are retained in intimate contact until separated under chosen equilibrium conditions. If the total vapor required is formed and removed in one step the process is termed single-flash vaporization. This, then, is one limit to the process of vaporization. Obviously the other is differential vaporization, the process of forming and removing vapor in successive infinitesimal amounts the summation of the differential increments giving the amount of vapor required. Information regarding this method of vaporization is obtained from the true boiling point analysis (T. B. P. curve) of a substance. Any process of vapor formation must be between these limiting methods, any vaporizer work between them.

The apparatus used was similar to that described by Leslie and Good, and other investigators. The petroleums and pressure distillates were single-flashed in it at various temperatures, increments of 50 degrees F. being taken. Material balances on each run were kept in order to determine losses. Small amounts of water present in the crudes resulted in a steam-distillation effect, causing small errors in the work that was not corrected for. Average barometric pressure during the course of the work was 745 to 750 mm. of mercury. All volume percentages are corrected for water content.

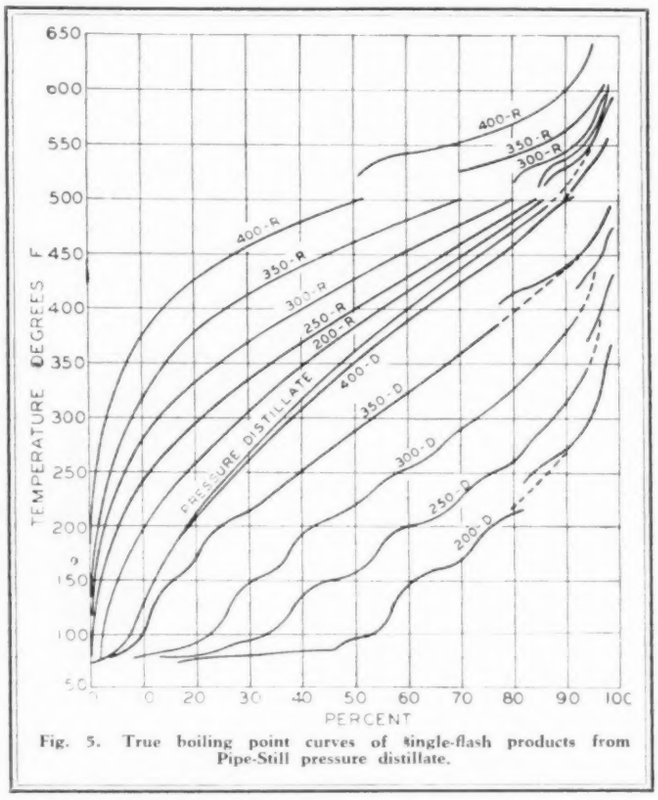

Fig. 5. True boiling point curves of single-flash products from Pipe-Still pressure distillate.

The single-flash products, distillate and residuum, were analyzed in a T. B. P. distillation column of the type, according to the method, described by Peters and Baker,[3] and Peters and Lesie.[4]

The materials used had the following characteristics:

1. A Prairie pipe-line crude, typical of mixed-base Mid-Continental crude, 38 degrees A. P. I. gravity, was obtained. It contained 41.2 per cent of 438 degree F. endpoint gasoline.

2. Petroleum from the Inglewood field in the Los Angeles basin is representative of Californian crudes containing little gasoline. The sample available had a gravity of 19.6 degrees A. P. I., contained 18.7 per cent of 437 degree F. endpoint material.

3. Pressure distillate, 46.6 degrees A. P. I., typical of the product made according to the usual batch process in a shell-still was used. It was dark yellow-brown in color, was

* Experimental work, reported here in part, was done in the Chemical Engineering Laboratories of the University of Michigan during 1926-27 under the supervision of Professor E. H. Leslie.

† Associate Professor of Petroleum Engineering, Colorado School of Mines, Golden, Colorado.

[1]Leslie and Good—Ind. & Eng. Chem., 19, 453 (1927).

[2]Ashworth—J. Inst. Pet. Tech. 13, 91 (1927).

[3]Peters and Baker—Ind. & Eng. Chem., 18, 69 (1926).

[4]Peters and Leslie—Oil Trade 17, No. 3, 37 (1926).

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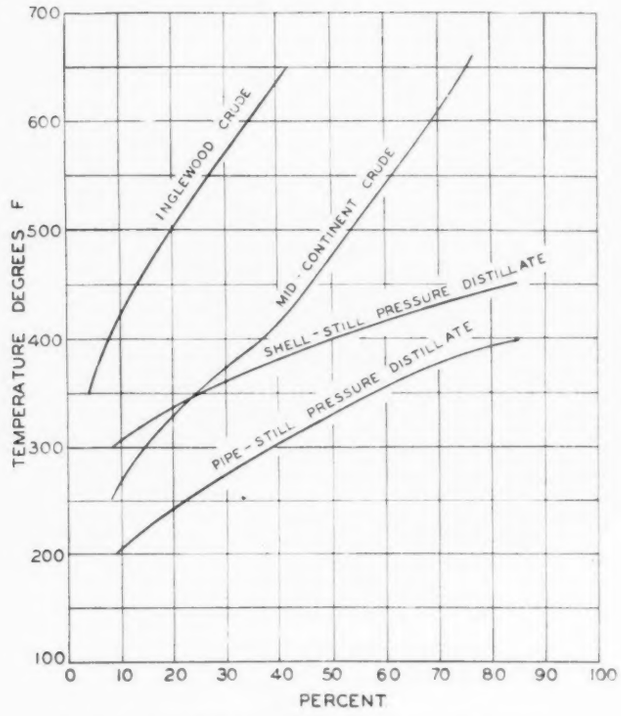

Fig. 1. Single-flash equilibrium vaporization yield curves.

sour, contained 56.5 per cent of 437 degree F. endpoint gasoline. The relative absence of the lower boiling hydrocarbons is distinctive.

4. A process pressure distillate, 73.2 degrees A. P. I., was chosen to represent the pipe-still product. It contained 72.0 per cent of 437 degree F. endpoint gasoline plus 3 per cent of highly volatile hydrocarbons lost in the distillation analysis.

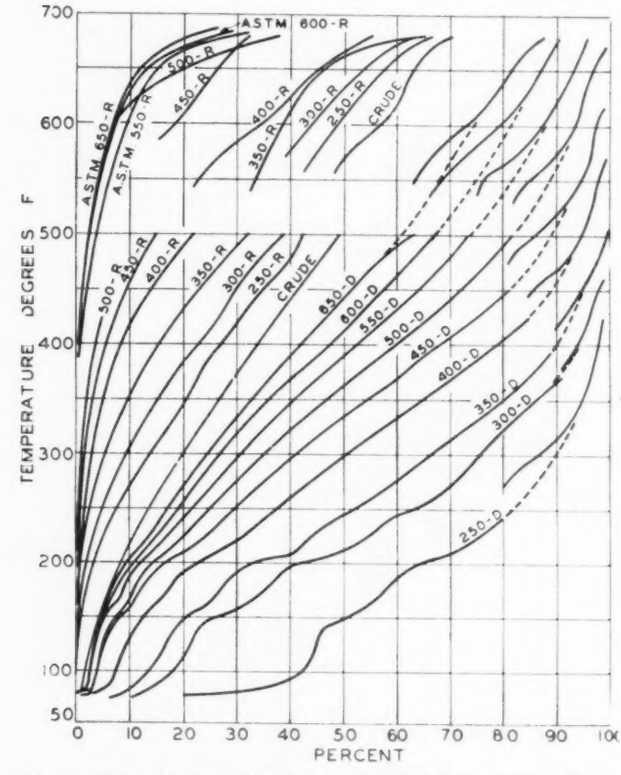

Fig. 2. True boiling point curves of single-flash products from Mid-Continent crude.

The amount of distillate produced under equilibrium conditions at various temperature is shown by the curves in Figure 1. It will be noticed that the yield curve for Mid-Continental crude exhibits a sharp break below 400 degrees F. These results were checked. Furthermore, material balances kept on each run definitely exclude loss of distillate as uncondensed vapor in explanation of this anomoly.

The slope of the yield curves for the pressure distillates necessarily is small, so that a difference of a few degrees in the temperature of flashing greatly affects the amount and nature of the products. The larger proportion of low boiling constituents in the distillate increases the slope of its yield curve compared to that of the batch pressure distillate.

True boiling point curves for raw material and the single-flash products at various temperatures of flashing are presented in Figures 2, 3, 4 and 5. All data are corrected for distillation loss by horizontal displacement of each curve equivalent to the percentage of distillate loss in each case.

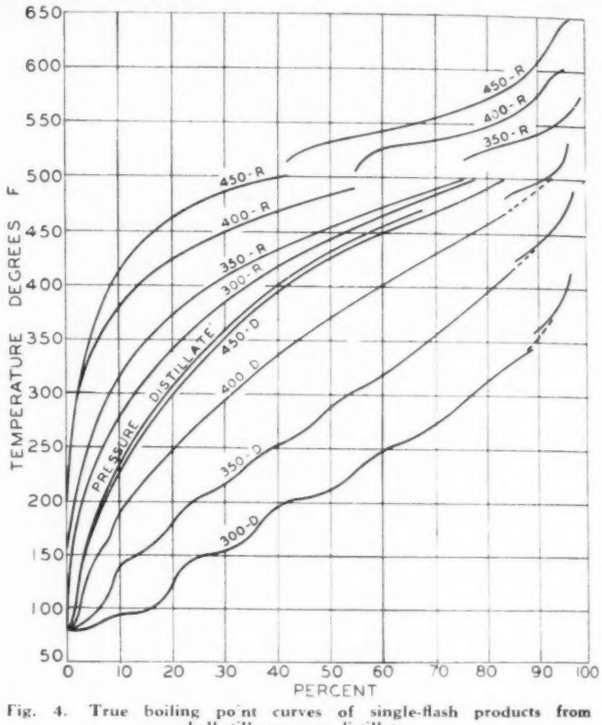

Fig. 4. True boiling point curves of single-flash products from shell-still pressure distillate.

This is essential to indicate the correct position of the curves relative to each other.

The highest boiling portion of each product was evaluated from an ordinary A. S. T. M. distillation of aliquot portions of the T. B. P. column residue. Intervening percentages are interpolated as shown by dotted lines in the Figures.

It will be noted that all single-flash residuums contain low-boiling compounds, all distillates high boiling ones, regardless of the temperature of flashing. A correspondence between the temperature of flashing of the crudes and the amount of material boiling below that temperature in the products may be noted.

An average of 80.8 per cent of the distillate from Mid-Continental crude, 8.9 per cent of the residuum, boils below the flash temperature as compared to 81.6 per cent of the distillate, 7.9 per cent of the residuum from Inglewood crude.

No correspondence between these factors is noted with pressure distillates other than the qualitative one, that, as the temperature of flashing is raised, the amount of material boiling below that temperature decreases in the distillate,

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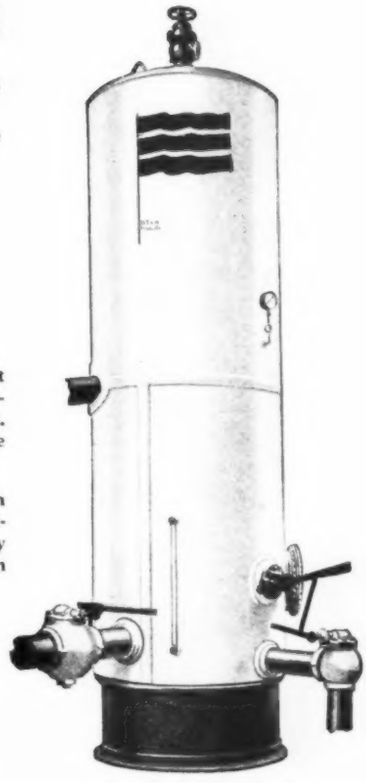

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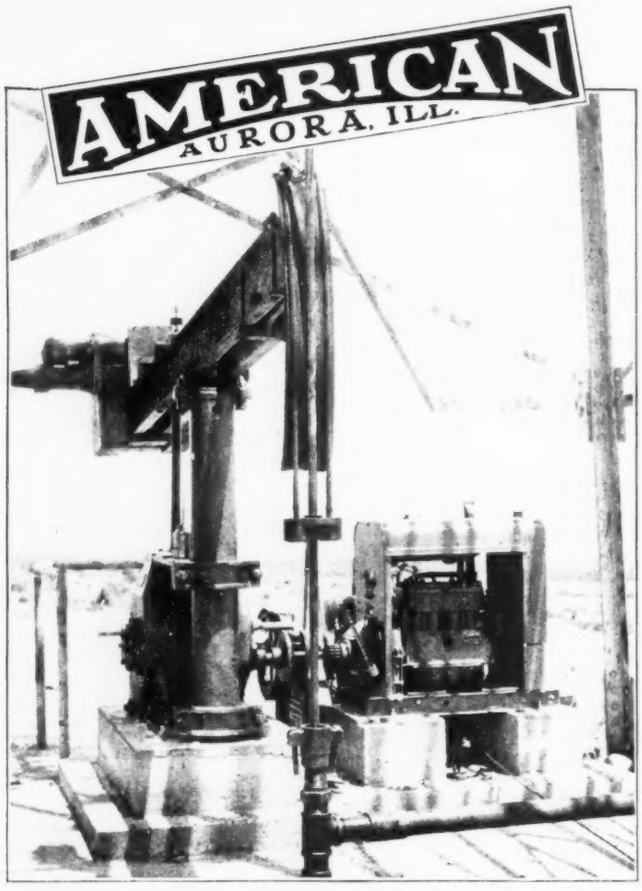

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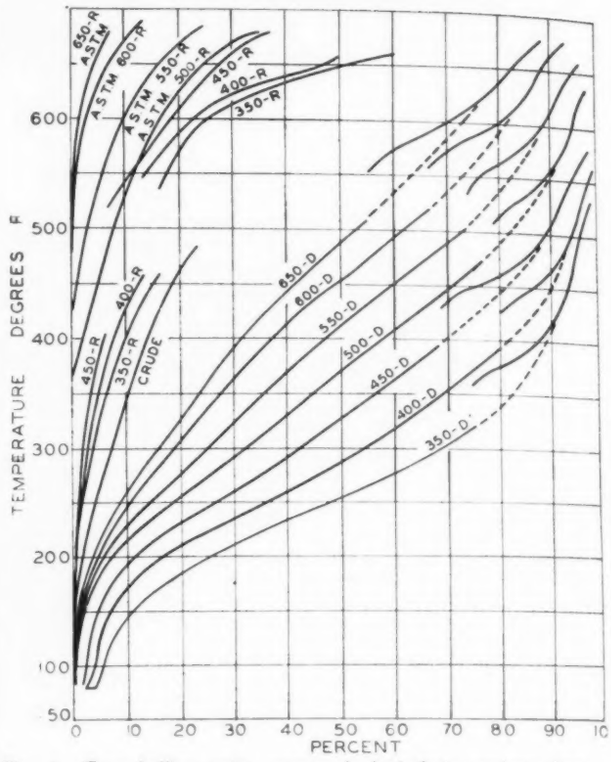

Fig. 3. True boiling point curves of single-flash products from Inglewood crude.

increases in the residuum, approaches a constant percentage. This behavior is related to the concentration in pressure distillates by means of similarity in one property, of compounds varied in chemical and physical properties, within a limited range of boiling points.

No simple quantitative relation is apparent between the distillation curves of the single-flash products from either petroleum crudes or pressure distillates.

While other data such as the A. S. T. M. distillation characteristics of the various products, gasoline fractions, residues, the material balances on runs, the characteristics, amounts of uncondensed vapors, the water contents of the crudes were determined, perhaps the only other thing of interest here is a tabulation of the gravities of the various single-flash products. This information is placed in Table 1.

TABLE 1

Characteristics of Single-Flash Products

(a) Specific Gravity @ 60 60°F.

Flash Temp. °F	M.C. Crude Resid.	M.C. Crude Dist.	Inglewood Crude Resid.	Inglewood Crude Dist.	Shell Still P. D. Resid.	Shell Still P. D. Dist.	Pipe-Still P. D. Resid.	Pipe-Still P. D. Dist.
200							0.7894	0.6637
250	0.8503	0.6934					.7983	6913
300	.8573	.7174			0.8062	0.7205	.8232	.7253
350	.8689	.7378	0.9548	0.7681	.8127	.7517	.8320	.7470
400	.8791	.7547	.9492	.7839	.8206	.7785	.8363	.7703
450	.8945	.7670	.9556	.8033	.8262	.7904		
500	.9033	.7769	.9672	.8177				
550	.9122	.7893	.9760	.8317				
600	.9244	.7974	.9833	.8453				
650	.9338	.8044	.9925	.8574				

(b) °A.P.I. @ 60/60°F.

200							47.8	81.7
250	34.9	72.6					45.7	73.2
300	33.6	65.7			44.0	64.9	40.4	63.6
350	31.4	60.3	18.1	52.7	42.6	56.7	38.6	57.9
400	29.5	56.0	17.6	49.2	40.9	50.3	37.7	52.2
450	26.7	53.0	16.6	44.6	39.8	47.5		
500	25.2	50.6	14.8	41.7				
550	23.6	47.7	13.5	38.6				
600	21.6	45.9	12.4	35.9				
650	20.0	44.4	11.7	33.5				

When writing THE AMERICAN WELL WORKS, *please mention The Petroleum Engineer*

Capitol Steel & Iron Enters Oil Field

THE Capitol Steel & Iron Company of Oklahoma City with a large, new fabricating plant just completed, announce entry into the oil field equipment business as pertains to structural steel.

It is announced that the company has completed design and are now in production with a full line of derricks, cable, rotary and combination, heavy welded steel walking beams, "A" frame sampson and jack posts and similar steel equipment.

The company is especially proud of its heavy 122-foot combination derrick. This derrick has 8 x 8 angle legs and is so designed as to withstand very heavy loading conditions without reinforcing. Officials of the company state that with reinforcements, which they are prepared to furnish, the derrick will safely carry such loads as are incident to drilling a 10,000-foot well.

Stiegel & Jefferson, Inc., Firm Announced

A NEW partnership known as Striegel & Jefferson, Inc., has been formed in New York City, with offices at No. 5 Beekman Street.

Ed. H. Striegel, formerly with Furnace Engineering Company, Inc., New York; Union Iron Works, Erie, Pa., and for the past two years New York representative of Drake Non-Clinkering Furnace Block Company, Inc., New York; and E. R. Jefferson for the past eleven years with Bernitz Furnace Appliance Company, Boston, Mass., with eight years experience as its New York Manager, are the partners.

Equipment represented by Striegel & Jefferson, Inc., includes the complete line of Drake Non-Clinkering Furnace Block Company, Inc., New York, and King Refractories Company, Inc., Buffalo, N. Y.

New Distributors for Ohio Injector Company

THE Oil Well Equipment Company of Los Angeles, California, and its branches have been made distributors for the Ohio Injector Company line of standard, medium and high pressure valves in bronze, iron and semi-steel.

Mid-Continent Company Places Stocks in California

STOCKS of the products manufactured by the Petroleum Equipment Company and the Oil Field Engineering Corporation are being placed in Los Angeles. G. D. Hall will be the California representative for both companies and will maintain offices at 1506 Santa Fe Avenue.

Mr. Hall was formerly with the Guiberson Corporation at Dallas.

New Specialty Products Distributing Concern

A NEW company has been formed for the distribution of specialty products in California, to be known as the California Bettis Company. The principal product will be the Bettis Protectors and Drill Stabilizers, although certain other specialty products will be handled including the Red Devil steel rotary hose and a rotary mud-screener.

Formation of the company is in line with the policy of the Bettis interests to be more closely identified with the industry and to be of greater service. The officials of the company include the following men who have been associated with the distribution of Bettis Protectors in California: Harry Taylor, Jess W. Hughes, Paul Medearis, and George Terry.

Headquarters will be maintained in the Insurance Exchange Building, Los Angeles, and it is the intention of the company to have its service engineers cover every California field daily.

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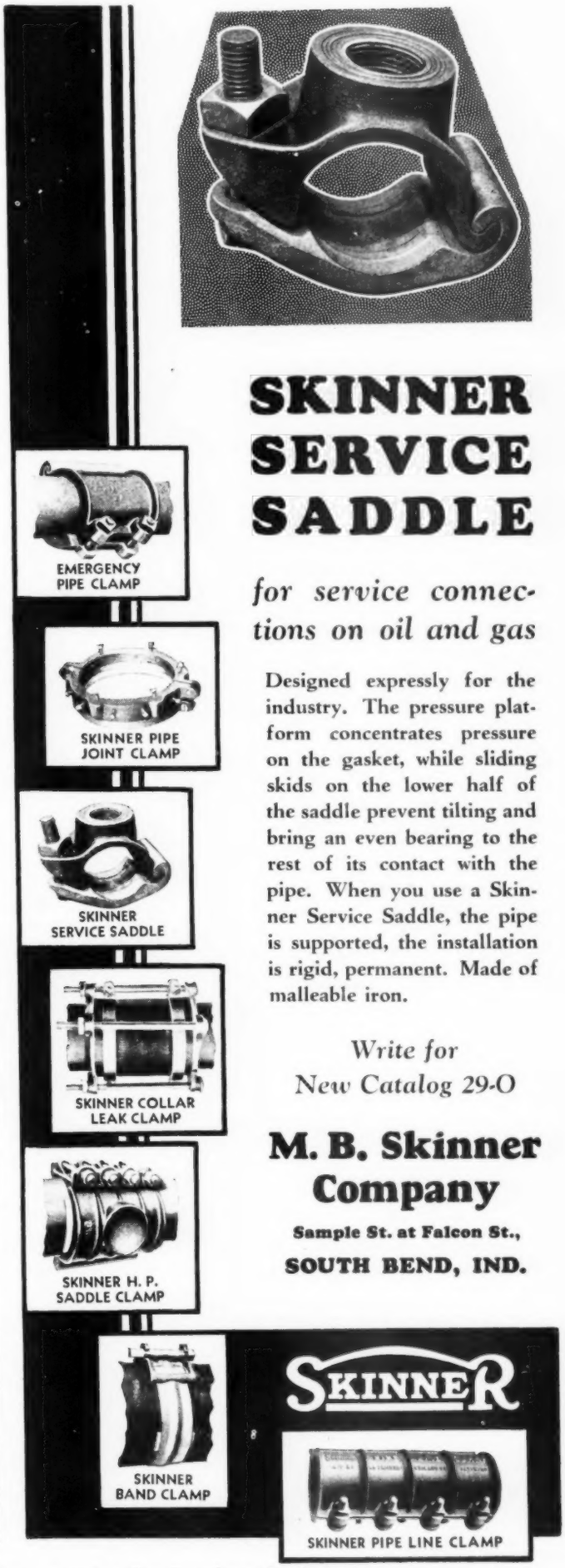


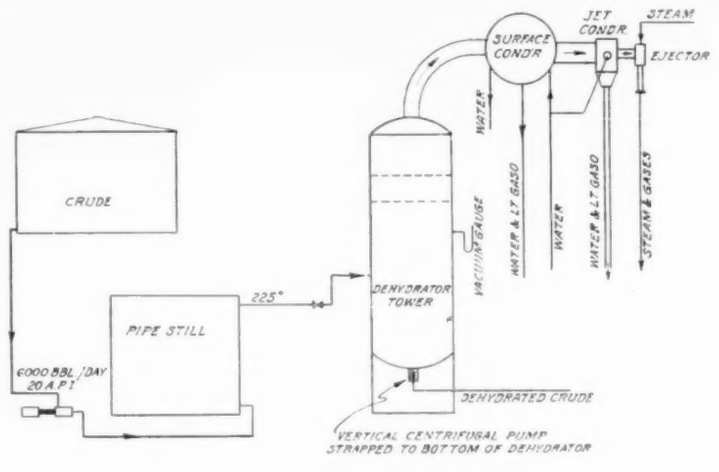
When writing M. B. Skinner Co., *please mention The Petroleum Engineer*

Vacuum *and* Chemical Process *for the* Dehydration *of* Emulsions

OIL companies have rightly encouraged in recent years, both cleanliness and safety first, and the results have more than justified their efforts. Why not proceed a step further and introduce economy as a subject of contest? They have nothing to lose and much to gain.

How much more attractive is that lease whose surface is unmarked by patches of oil and B.S., whose equipment is tightened down and all loose material properly stacked, to one whose surface covering might have been the work of some gigantic Cubist painter with a marked penchant for black coloring? There can be no question which of the two leases has the smaller expenditure. That of the ebony hue represents much lost income in oil loosely handled and B.S. turned away in ignorance of the fact that all basic sediments can be treated to yield almost the maximum content of pipe line oil to the exclusion of the other elements that go to make up the emulsion, namely water and foreign matter.

The Smackover field, Arkansas, which has seen much waste, more bad treating and lots of non-treatment of emulsions, is the scene of an interesting development of emulsion cures. This is the method developed by S. Dayson, late vice-president of the Lion Oil Refining Co., at their refinery in El Dorado, Arkansas. Briefly, the principle is the breaking down of the emulsion and the separation of the water by the joint application of heat and vacuum, and the judicious use of chemicals.



Diagrammatic sketch of vacuum unit at Lion Oil and Refining Company's plant at El Dorado, Arkansas.

At the present time there is a pronounced trend toward the use of vacuum in various refinery processes. The recovery of sulphuric acid by the vacuum process has been in successful refinery use for some years, and recently a great many vacuum distillation units for production of lube distillates have been put to use. The advantages of these processes are well known.

The further use of vacuum as exemplified by the Lion Oil Refining Co. at El Dorado, Arkansas, is worthy of note by all refiners. This refinery is processing Smackover crude of 20-21 A.P.I., which often contains from four to eight per cent B.S. and water, mostly water. It is necessary to dehydrate this crude before running through heat exchangers, as the oil, when heated to the vaporization temperature of the water, deposits a considerable quantity of salt, which soon blocks the exchanger tubes.

The method previously used consisted of heating the oil to 300 degrees F. in a tubular heater, and flashing in a tower at atmospheric pressure; however, considerable trouble was experienced due to deposition of salt in heater tubes, necessitating frequent cleanings of tubes and occasionally causing a tube failure. The new system of operation is shown on the flow diagram illustrating this article.

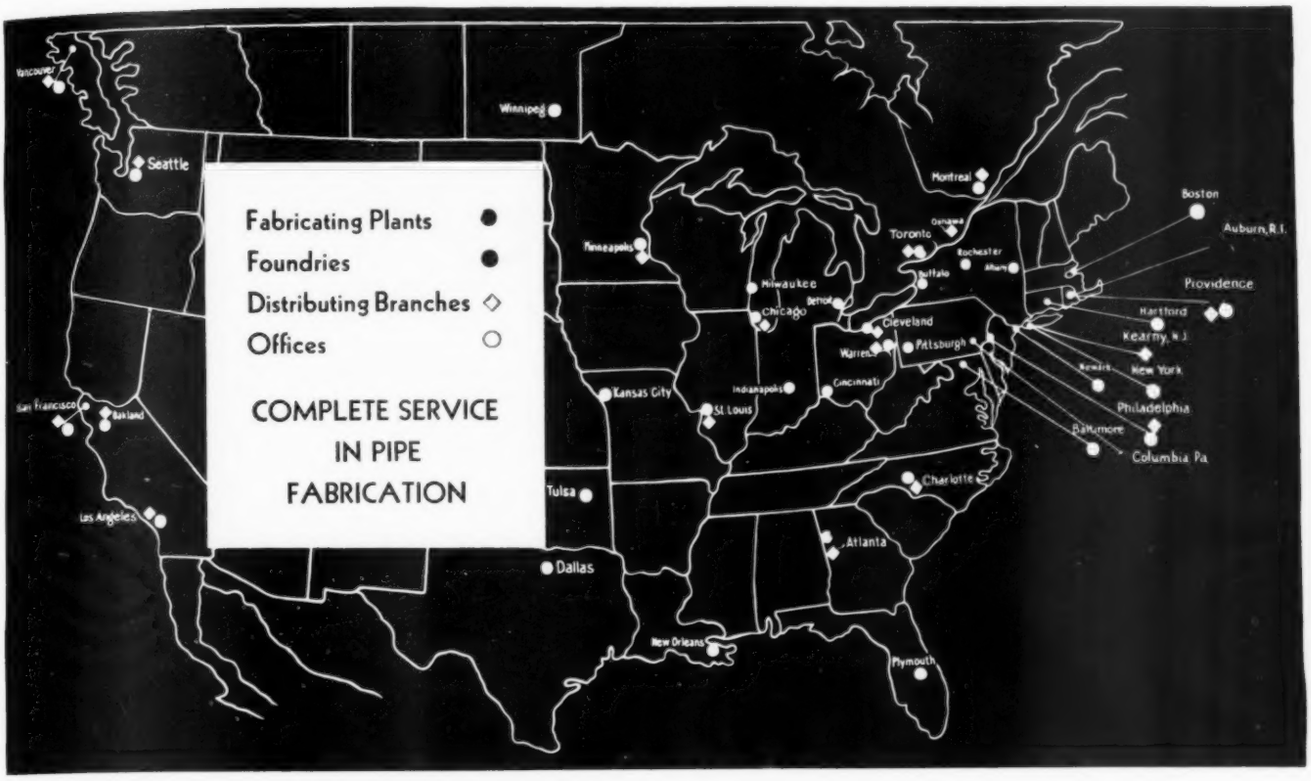
The vacuum ejector is designed to secure a vacuum of from 75 m.m. to 150 m.m. (absolute pressure), depending on the character of crude charged. The rated throughput is 6,000 barrels per day of crude running up to eight per cent B.S. and water. The reduction of vapor pressure due to this vacuum is such that the pipe still outlet temperature may be reduced to 220-230 degrees F. At this temperature, no trouble is experienced from salt deposition in the tubes.

When the crude after dehydrating is charged directly to a distillation unit, the vacuum dehydrator shows little economy in fuel, since the higher temperature for atmospheric dehydration is utilized as pre-heat in the charge. The only difference is the sensible heat required to raise the water in the crude to the higher temperature. However, when operating as an independent unit, the vacuum dehydrator shows considerable fuel saving over atmospheric dehydration. This saving, when processing a crude containing five per cent moisture (an average figure), and assuming 70 per cent pipe still efficiency and 950 B.T.U. gas, amounts to 115,000 cubic feet of gas per day. There is in addition a saving in the smaller quantity of cooling water required.

The vacuum ejector handles from 100 to 200 pounds of air and fixed gas per hour, the absolute pressure varying directly with the amount of fixed gases. The cost of steam to operate the vacuum ejector is only $2.50 per day.

The dehydrator is some 10 feet by 30 feet, suitably reinforced, standing on a circular concrete wall about 10 feet high, with spaces left in the upholding wall to permit men and material being taken into the base of the tower. Welded directly into the bottom of the tower is a 2-stage vertical centrifugal pump, equipped with a bottom drive power unit, a steam turbine, the two being connected by a flexible coupling.

The whole system is under almost complete automatic



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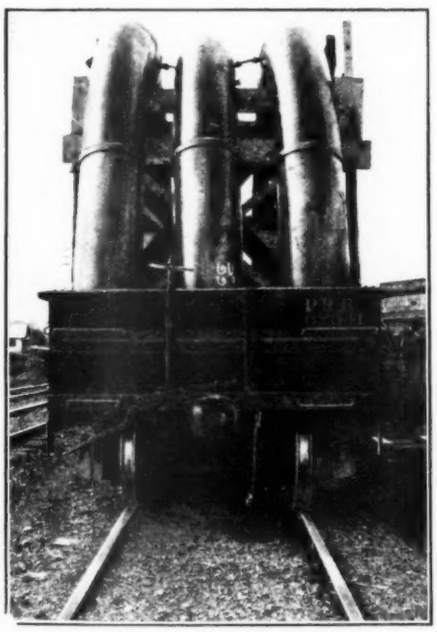

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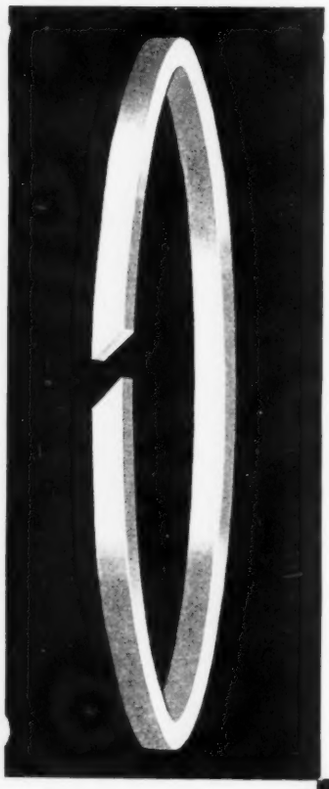

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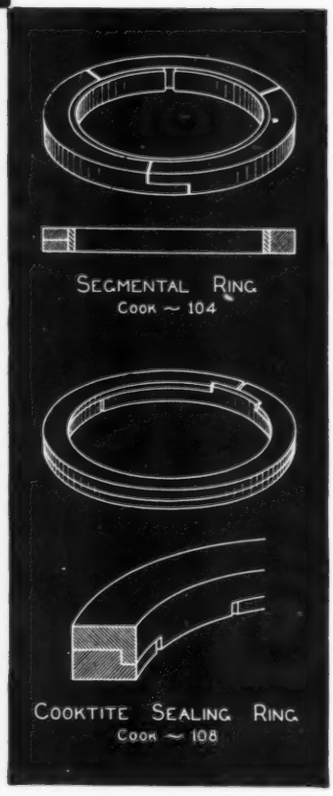

*Cook's Graphitic Iron is an exclusive material obtainable only in piston rings manufactured by C. Lee Cook Manufacturing Co.

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control. A liquid level control of suitable make and merit is operated from the tower to the diaphragm valve on the discharge side of the centrifugal pump, and closes down on the pump when the liquid level in the dehydrator is low. No harm befalls the centrifugal unit running against a closed discharge valve, and this feature is of immense value in a plant where the minimum of help is aimed at and where the operator is given plenty of freedom to move around and watch more closely the other parts of the refinery operation that follow the dehydrating.

Periodic tests are made to determine the B.S. content of the treated oil, the results giving a line on what should be carried on the dehydrator in the way of both vacuum and heat. The limits of the emulsion content can be absolutely perceived by this dual control.

From the dehydrator the treated throughput is passed to a vacuum distillation tower, where the operation end desired is asphalt. The State of Arkansas is laying many miles of asphaltic road and the product of the Lion Company is widely used. It was to meet the demands made for this commodity that this Arkansas refiner built this complete unit, and the results have exceeded expectations.

Tank Bottoms

There is, too, the benefit of keeping storage tanks more free from the cluttering of their bottoms. If oil with a high percentage of B.S., even that prescribed by the pipe line companies when buying their oil at different leases, is permitted to flow for a long time into those 55,000 and 80,000-barrel storage tanks, there is to be faced sooner or later the disagreeable task of cleaning out several feet of solid emulsion that has accumulated in the bottom of the tanks by the B.S. falling through the oil and coming to rest on the bottom. Early treatment so that all the B.S. is dehydrated would effect a saving in both money and extra storage capacity.

A gathering system, whose size depends on the volume in question, is another item of expense, and on that point there is encountered the natural antagonism of the pipe line companies to have their lines contaminated by cut oil. Were these emulsions to traverse such lines slowly and at times cease to have any forward motion at all, there would occur the inevitable deposition of B.S. in solid form. In time the capacity of the line would be considerably reduced, an evil which would be very expensive, considering the present-day cost of pipe.

As a certain deterrent to B.S. deposition in the gathering lines and forwarding lines, emulsion treating chemicals of the tried suitability could be mixed with the cut throughput in a tested percentage, proportionate to the volume passed. The mixing essential to the most efficacious employment of the chemical would result from the travel in the carrier, with best results obtaining from long travel. The chemical, thus well mixed, would ensure the breaking down of the emulsion to its two component parts of oil and water. In this state there is nothing that would cause the partial plugging of the pipe, unless it be a little free salt. But with no heat applied to the oil, there is little chance of the water losing its salt solids.

In conclusion, it would appear that Mr. Dayson rendered the oil industry a signal service, Smackover something savoring of salvation, and has given producers something which, embracing heat, vacuum, and chemical, can be applied to their treating troubles to their financial gain.

When writing C. LEE COOK MFG. CO. *please mention The Petroleum Engineer*

International Supply Opens East Texas Store

INTERNATIONAL SUPPLY COMPANY of Tulsa announces the opening of a new store for East Texas. The store is located at Kilgore, in the center of the widespread activity and new oil production in Eastern Texas. G. A. Chaney is in charge of the store.

Resistcor Engineering Moves

RESISTCOR ENGINEERING CORPORATION has moved its office and warehouse to a new building located on Third at Frankfort Avenue, Tulsa. The enlarged facilities will enable them to greatly improve their service.

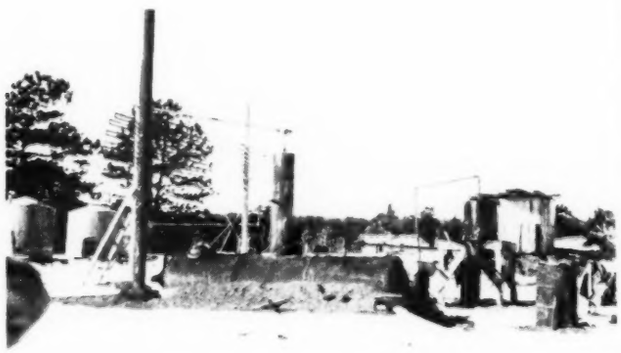
National Tank Opens Kilgore Store

THE NATIONAL TANK COMPANY of Tulsa has opened a store at Kilgore, Texas, to serve new East Texas developments. Howard Ammerman is in charge of the new branch store.

Many Small Refineries Building in Wyoming

THE low crude market has cut down field work in the Rocky Mountain states to a minimum and in some fields the operators are having trouble selling their oil. The small operators of the Osage Field of Wyoming have hit upon a novel way of marketing their crude.

The Osage Field in Wyoming is a monocline terrace and the oil is found in the muddy sand that rises on this monocline to the Black Hills, in fact the field is located upon the flank of this great uplift. The erosion of past ages has cut off the surface so that wells are found near the escarpment of the muddy sand at depths of 60 feet and down at the south end of the field the thickening of the cover over the sand causes the wells to be drilled 1,500 feet.



Small skimming plant in Wyoming.

Because of the low price, many of the operators could no longer produce their wells at a profit so have turned their attention to other channels for marketing the oil.

The field lies on the Custer Battlefield Highway and the Black and Yellow trail, No. 16, of the Federal highway system and this road is one of the main arteries of travel. Accordingly many of the oil operators of Osage have decided to sell their production direct to the consumer and a host of small refining plants are springing up along the highway where gasoline cut from Osage crude is sold.

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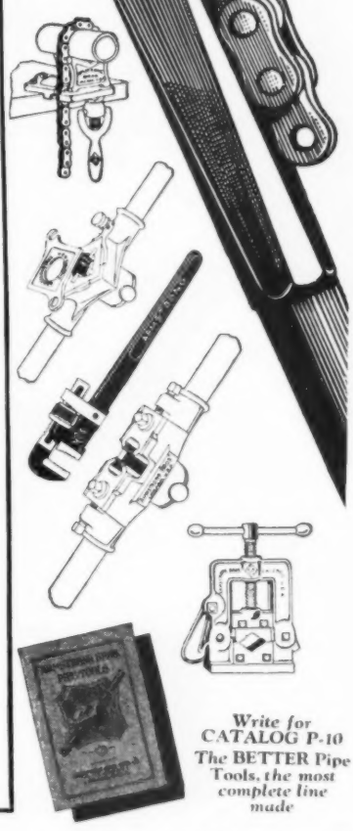

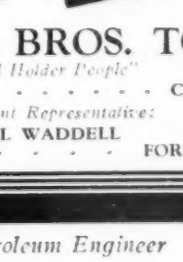

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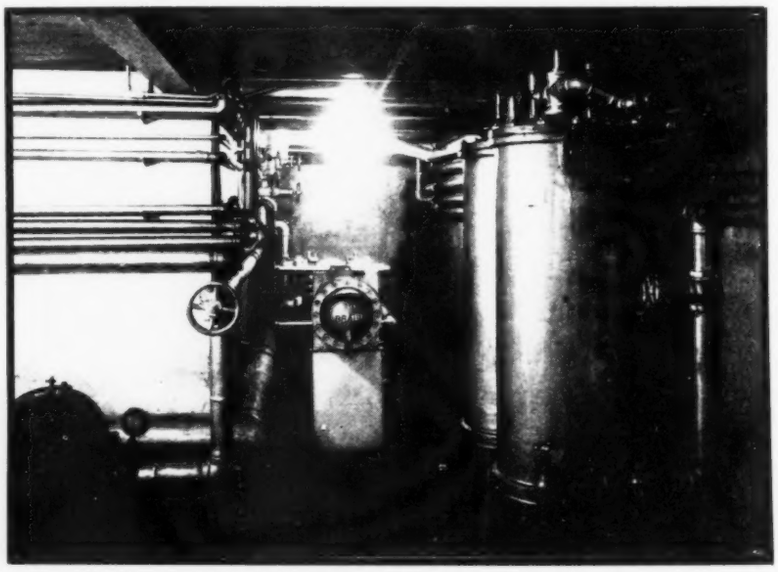
Some Problems of » » » »

Diesel Cylinder Lubrication

By E. H. HILLMAN, *Technical Division Standard Oil Company (Indiana)*

COMPRESSION ignition engines have encountered a variable history since their invention by Dr. Rudolph Diesel in 1892. For many years, the spark ignition gasoline engine has held undisputed leadership except for low speed heavy duty stationary service. Diesel or compression ignition engines are, however, becoming of more significance in the automotive and light stationary fields, and enthusiasts are not wanting who predict that such engines might become a very important factor in truck and tractor propulsion. It is not surprising that increasing attention has been given to their lubrication.

The advantages of the Diesel engine are due principally to its great efficiency as a prime mover, particularly when operating at low loads, and to its ability to carry heavy loads at low speeds. These factors have added to its popularity in oil pipe line work. Also it can burn heavy liquid fuels, thus eliminating the fire hazard. It is not, however, true that such fuels will necessarily be lower priced than gasoline, considerable propaganda to the contrary notwithstanding. Fuels suitable for modern high speed compression ignition engines must be manufactured to a rather high degree of purity and uniformity for satisfactory operation. Under present manufacturing methods, these fuels are available in smaller quantities than gasoline and can, if necessary, be converted into high grade gasoline by cracking. More attention is being given to the cleanliness of Diesel fuel, and standard practices in many industrial installations require that the fuel be centrifuged in order to eliminate the injection of impurities. In any case, Diesel engines will, however, continue to be an important source of power, and their lubrication is worthy of study.



Heat exchanger for cooling lubricating oil with cold jacket water.

Diesel cylinder lubrication should be considered from three angles:

(a) CLEANLINESS OF THE OIL: Its resistance to carbonization around the pistons and rings or in the exhaust passages, and resistance to sludging if the same oil is used in the crankcase.

(b) RATE OF CYLINDER AND RING WEAR: Ability of the oil to protect the moving parts against wear at high temperatures.

(c) POWER LOSS FROM FRICTION: The amount of power required to overcome the internal friction of the oil.

Diesel cylinder oils may be considered from other angles than the above, but it will be found that all important characteristics are included in these three classifications. Results of studies to measure the necessary qualities in lubricants to secure the best results in these characteristics will be presented.

Cleanliness of the Oil

Diesel engines are more subject than other internal combustion engines to carbon formation on pistons and rings and, in some models, to carbon accumulations in the exhaust passages. The reason for this lies undoubtedly in the higher compression pressures necessary to secure ignition without the use of the electric spark. Such high pressures and resulting high temperatures, even though present only momentarily during a part of the stroke, will necessarily subject the oil to more deterioration than in other engines. This carbonization resulting in stuck or gummy rings with blow-by and lost power, and partial clogging of the exhaust passages, with decreased efficiency, has in the past been an important factor in preventing the most economical use of Diesel engines.

It has heretofore been the practice to rate Diesel oils as to carbon and gum-forming tendencies in the engine on the basis of the Conradson carbon or carbon residue test. This test may have some value when comparing lubricants made from the same crude and by the same manufacturing process, but experiment has shown it to be of no value for the comparison of lubricants by the user, who necessarily will have no knowledge of source or refining methods. This has been shown by tests in typical Diesel engines running over some two years and so arranged that carbon accumulations were obtained and weighed at regular intervals. A variety of oils were tested in this way under uniform operating conditions. Typical results are shown in Table I on page 192.

No laboratory tests, other than the Conradson test, have been accepted as having value for measuring carbon or gum-forming tendencies of an oil. Others have been suggested, particularly the Vacuum Distillation test, but sufficient information is not available to prove its value for Diesel service. All other tests, such as gravity, flash, cold

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test, etc., are known to have no significance from this standpoint.

It is becoming generally accepted that tests in service are essential for Diesel lubricant evaluation, but it must be kept in mind that variations in operating conditions, such as degree of cylinder and ring wear, cooling water temperature, timing and fuel distribution, exhaust gas temperature, load on the engine, mechanical condition, etc., all exert an important influence on results so that great care is necessary to secure the utmost uniformity of operating conditions. In many plants it is thus impossible to run worthwhile comparative tests, so that the selection of proper lubricants must be made on the basis of field tests conducted elsewhere.

Rate of Cylinder and Ring Wear

The feeling is prevalent that wear decreases as oil viscosity is increased within moderate limits. This seems reasonable but is not adequately supported by available experimental data and should be the subject of further investigation.

Excessive wear does not ordinarily show up in the bearings because the lower temperatures of such service almost always permit even moderately light oils to lubricate properly. Oil films of suitable thickness are built up in the bearings except, of course, under abnormal conditions. Failure of wrist pin bearings is somewhat more common because of the high temperatures, but this also should be of slight economic importance. Cylinder and ring wear is more serious, especially in the larger engines such as are commonly used in power plants and pumping stations where cylinder liners and rings must be replaced at intervals so frequent that cost is of considerable economic significance.

This wear increases blow-by and thus loss of power, especially with heavy loads, and causes more rapid deterioration of the oil. Blow-by due to excessive wear is shown clearly in Figure "A" where extensive gumming and carbonization have taken place in the path of escaping gases. Diesel piston rings have been designed to remedy this condition by construction such that there is no gap at the ends through which hot gases can escape. This type consists of two rings, one fitting in a slot or groove cut in the other. Inasmuch as the gaps are at different points there is no passage for gases to pass by the rings, either when they are new or after cylinder or ring wear has taken place.

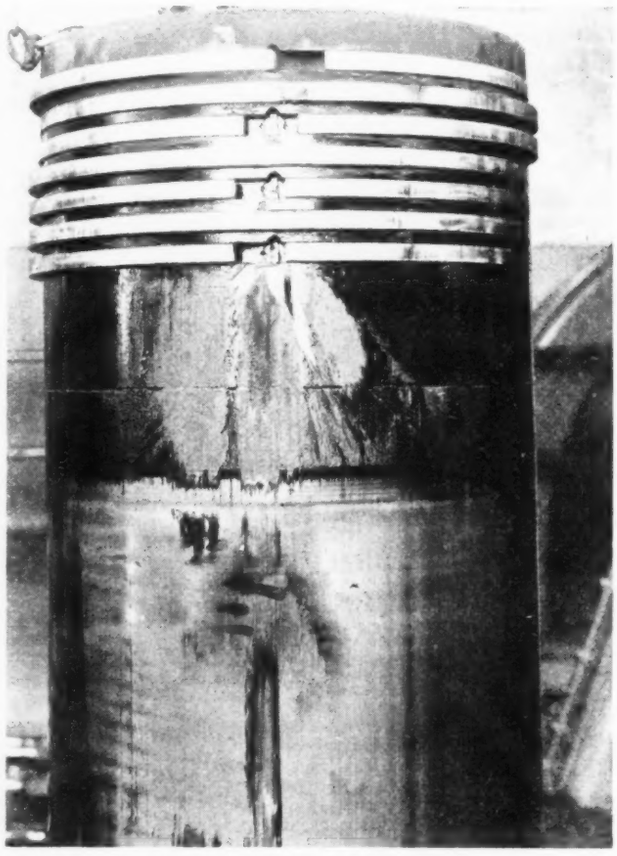

Fig. A. Oil-deterioration caused by blow-by.

The reduction of cylinder wear is particularly important inasmuch as it is more expensive to replace cylinders and rings than other Diesel parts which are subject to wear. There have therefore been attempts to improve this condition by the use of superior grades of cast iron or alloys.

Cylinder wear measurements, to be of any significance, must be determined over long runs, under substantially uniform conditions. For instance, when it is considered that with ordinary micrometers, measurements cannot be made with any accuracy to closer than 0.0005 inch and that large Diesel engines show a cylinder wear of only 0.001 inch after from 150 to 1,500 hours, it is apparent that long runs of about six months should be made to secure reliable data.

One large Diesel user expresses the rate of wear as the number of hours which the engine runs for each 0.001 inch increase in cylinder diameter, and has made a rather extensive study of cylinder wear by this method for the past several years. While, of course, cylinder wear depends to a large extent on operating conditions, it has been possible to determine in a general way the wear-reducing characteristics of different lubricating stocks.

Tests made along the above lines are at present so scattering that definite conclusions cannot be drawn, but it appears that in some instances moderate increases in viscosity over typical recommendations of several years past are indicated. Formerly, such recommendations would have involved difficulties with carbon formation since heavier oils form more deposits under the same conditions than do lighter oils. With the improved manufacturing processes now in use, it is, however, possible to combine moderately higher viscosity with even better carbon forming characteristics.

Power Loss From Friction

Diesel oils, like all other lubricants, should show minimum power losses due to friction. The operator is prone to lose sight of this factor, since moderately excessive fuel consumption escapes notice, whereas excessive wear or excessive oil deterioration is at once apparent. This should not be the case, since fuel losses from an improperly selected lubricant may be appreciable. A survey of the literature on lubrication shows that fluid friction and hence power loss is proportional to the viscosity of the lubricant at the point of lubrication, being greater for higher viscosities.

Fuel consumption tests in a Diesel engine have shown this quite clearly. In one case a reduction of 500 seconds in viscosity at 100 degrees F., caused a decrease in fuel consumption of 3.7 per cent, which was almost constant for moderate variations in load. In this test the same fuel was used throughout and was very carefully measured for each run. This difference in fuel consumption appears rather large and quite likely is not typical. In any event, it would seem that an appreciable difference exists. The lubrication engineer must keep this factor in mind and always use as light a lubricant as is consistent with satisfactory operation and rate of wear. In Diesel lubrication particularly, friction losses are higher than in other prime

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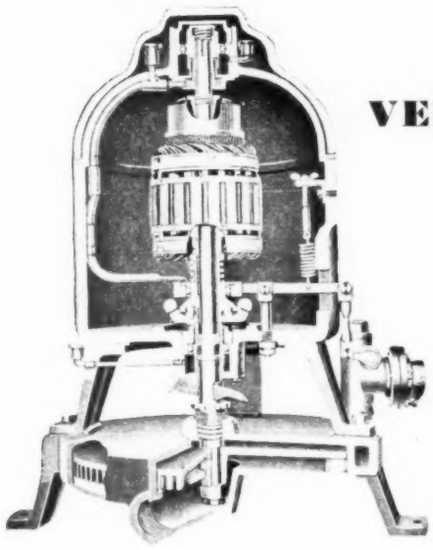

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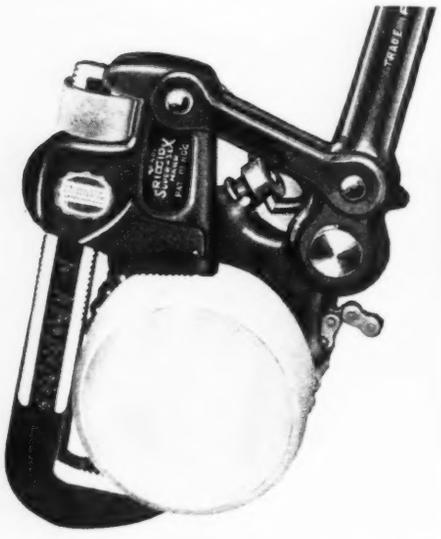

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movers, so that this point merits especial consideration. Also, the temperature viscosity coefficient of the oil should be considered to secure low friction losses on starting in cold weather. In hot weather, this factor is not important.

Friction losses in Diesel engines consume from 15 to 25 per cent of the indicated horsepower, according to Otto Nonnenbruch in "Power Plant Engineering" for March 1, 1929. These losses are approximately constant for all loads and for the various types of engines are as shown in Table II:

TABLE II.
DIESEL ENGINES—EFFICIENCIES.

Engine Type	Friction Loss lbs. per sq. in Mean Pressure
Four-cycle, Air Injection	18-20
Four-cycle, Solid Injection	13-16
High Speed	30
Supercharged	23
Two-cycle, Outside Scavenging	13
Two-cycle, Scavenging Pump	21
Two-cycle, Crankcase Scavenging	18

Oil Consumption

While not of fundamental importance from the standpoint of lubrication, plant economy always makes oil consumption of vital interest to the operator. As in the case of motor oils, higher viscosities also usually result in lower oil consumption, although greater power loss as discussed above. In the case of engines which are in poor mechanical condition or overloaded, this saving may be quite important, but under ordinary conditions the difference may not be great.

Because of possible reduction in wear and, frequently, a reduction in oil consumption there is a trend to the use of heavier oils for Diesel cylinder lubrication. This has an analogy in the automotive field where the use of heavier oils is sometimes carried to an extreme because of smoother operation as well as reduced oil consumption. The objection heretofore has been that such heavier oils have increased carbon deposits, but modern refining methods minimize this difficulty so that now less wear and lower oil consumption can be obtained without trouble from carbon deposits.

Significant Laboratory Tests

Viscosity is, of course, the fundamental test showing the friction loss which may be expected on well lubricated surfaces and, it now appears, showing within reasonable limits the amount of wear which may be expected. It must be remembered that the significant figure is the viscosity at the temperature of the bearing surface. Viscosities are ordinarily taken either at 100 degrees or 210 degrees F., neither of which may be at all close to the operating temperature. Even so, a true comparison might be obtained if the temperature susceptibility of all lubricating stocks were the same. However, this is not the case. For instance, two oils having a viscosity of 63 seconds at 210 degrees may have from 420 to 800 seconds at 100 degrees F. The significant part of the cylinder from a lubrication standpoint is, of course, the upper part where temperatures are the highest. The temperature at this point is frequently above 210 degrees F., but inasmuch as this is the highest temperature at which viscosities are taken commercially, it appears obvious that viscosities at this temperature should be considered for a Diesel cylinder lubricant.

The pour point is of no significance for the great majority of Diesel installations which are usually in heated engine rooms. Engines in small isolated power houses or pumping stations where there are no heating facilities may, however, require a low cold test cylinder oil in cold weather to insure adequate lubrication.

Flash increases with viscosity and is influenced somewhat by methods of refining and source of the crude, but is now believed not to be of sufficient accuracy as a measure of volatility to be of much assistance in a study of oil consumption or deterioration.

Other common laboratory tests have been considered in the discussion of carbon forming characteristics, above.

Cylinder Lubrication Factors

Many factors indirectly affect the cylinder lubricant such as engine size, speed, type of cycle, combustion characteristics, fuel injection method, piston cooling method, cylinder cooling, type of fuel, piston ring type, and air condition.

It would appear that from the standpoint of lubrication most of these are important only in that they contribute to the Mean Effective Pressure at which the engine operates. Factors of design and operating conditions have as their resultant a Mean Effective Pressure. The higher the Mean Effective Pressure the higher the average temperature to which the oil on the cylinder wall is subjected.

The amount of heat absorbed by a piston head is proportional to its area (or D^2), while the amount dissipated through the piston walls is proportional to their circumference or diameter (D). Therefore, the larger the diameter (for the same type of piston), the higher the temperatures which will be built up on the piston walls and rings. Where the general type of engine is the same the oil film temperature and the strain on the lubricating oil should therefore be proportional to the M. E. P. x D, where D is the diameter.

The Brake Mean Effective Pressure (B. M. E. P.) can be calculated from the Formula $\text{B. M. E. P.} = \frac{1{,}008{,}000 \times \text{BHP}}{S\ D^2\ N\ n\ k}$

where BHP is brake horsepower, S is stroke in inches, D is bore of cylinder in inches, N is revolutions per minute, n is number of cylinders and k is two for two-stroke cycle, or one for four-stroke cycle engines. The brake M. E. P. should be roughly proportional to the indicated M. E. P. for engines of the same general type.

The indicated Mean Effective Pressure is not generally available since we do not know the friction losses exactly for each type of engine. On the assumption that friction losses would be proportional to the Brake Mean Effective Pressure, the factor B. M. E. P. x D has been worked out for a number of engines where data was available on the relative difficulty of lubrication.

Little correlation has been found in the few instances studied, probably because of the lack of comprehensive data and an infinite variation in other factors. However, it is believed that this method merits further study as a guide in the selection of Diesel oils.

Carbon formation, friction loss, wear and necessary oil consumption should be measured accurately in a variety of engines running under full load conditions. When these effects for a given oil and engine type are compared with the factor B. M. E. P. x D, a definite relation should be evident if the above assumptions are valid and this factor is a worthwhile tool for making lubricant recommendations. The practical application would be in the accurate selection of oil viscosity to meet any heat condition, avoiding on the one hand the evils of too high a viscosity and on the other the oil loss and wear and even lost power resulting from too light an oil. The viscosities recommended for a series of engines should on this basis vary according to B. M. E. P. x D.

This factor should be compared where engines are of the same type as regards piston cooling and combustion cycle. Engines should therefore be divided into four classes

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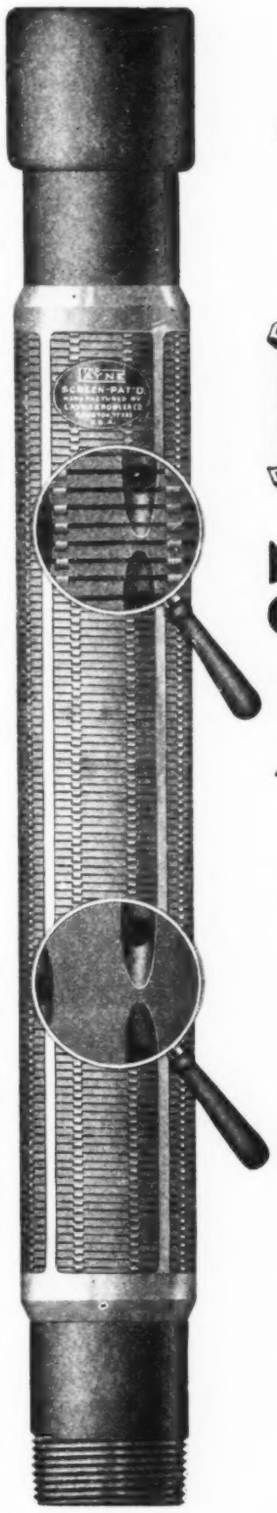

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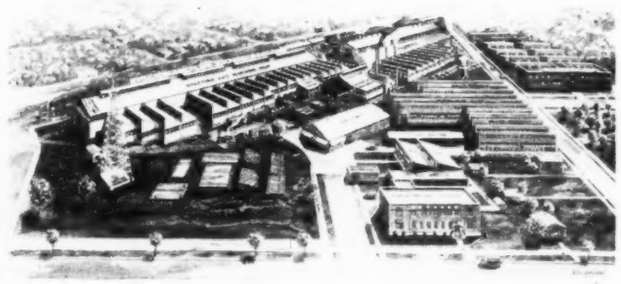
for such a study, as follows: A. Two cycle, no piston cooling; B. Two-cycle with piston cooling; C. Four-cycle, no piston cooling; D. Four-cycle with piston cooling. Probably other features of design, such as fuel injection and combustion chamber design could be neglected as having a minor influence on piston wall temperatures.

TABLE I.
OIL RATINGS IN DIESEL TESTS.

Oil	Engine No.	Conradson Carbon	Viscosity at 210° F.	Weight of Deposits In Exhaust Passages	Deposits Back of Rings
A	1	0.09	65	0.50	4.0
B	1	0.05	61	0.80	5.0
C	1	0.10	56	1.85	4.4
D	1	0.29	62	1.35	5.6
E	1	0.25	65	2.2	15.9
F	2	1.20	92	60.91	17.0
G	2	0.22	93	85.0	28.1

Note: The test conditions in Engine No. 1 were such that determinations of carbon formation on back of piston rings were not as exact as exhaust carbon measurements. Tests in both engines were such that each oil was compared under the same operating conditions and for the same length of runs. Carbon accumulations were secured from definite areas or rings and do not represent the total accumulations.

Lufkin Completes Expansion Program



WITH the completion of its new two-story brick office building, steel and brick fireproof pattern shop and storage building, a new wash and locker room for employes, the Lufkin Foundry and Machine Company of Lufkin, Texas, has just completed one of the largest expansion programs in its history. The fencing of its plant in its entirety was also a part of the building program.

In addition to the building program, a number of modern production machines were installed in the machine shop and foundry departments. Several tools, especially designed for the manufacture of Lufkin units, were added to its equipment.

The Lufkin Foundry and Machine Company was organized in 1900. Lufkin at that time was centrally located in the then thickly-forested pine belt of East Texas. Some of the largest sawmills of the South and West were produced in the Lufkin plant.

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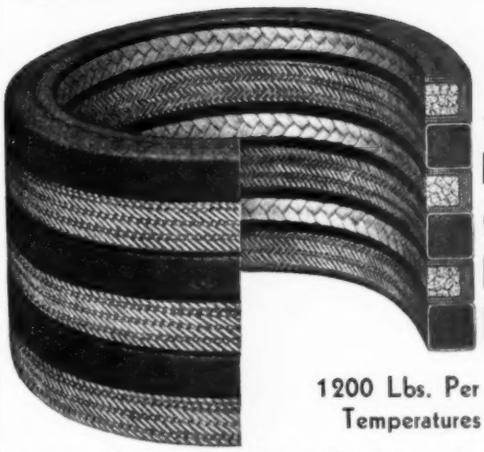

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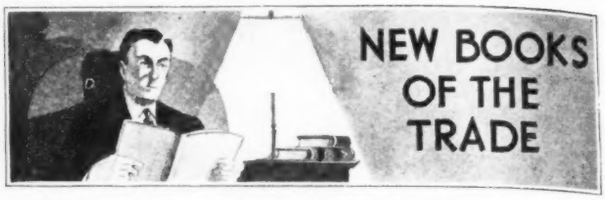

ANOTHER very interesting issue of Gas Service Journal has been distributed as the February copy. This magazine is published by the Pittsburgh Equitable Meter Company, Pittsburgh, Pa.

The lead article is entitled "Recent Developments in Liquefied Petroleum Gas Systems," written by W. G. Watkins, petroleum engineer and manager of the Skelgas Research Department. This story is well presented and illustrated. Another article of interest is that of Constance Wilson, Missouri Public Service Company, who writes about "The Gas Industry."

Several other articles of interest to gas men are carried in this Journal, which is published monthly.

Neilan Remote Manual Control System

NEILAN CO., LTD., Los Angeles, Calif., has issued a booklet entitled Neilan Remote Manual Control System. This booklet is being distributed to those interested in the subject.

This control system has been developed for operating a distant Diaphragm Control Valve by means of a handwheel located on a centralized control board. Full description of the equipment, its abilities, are given, together with many illustrations in the booklet.

Natural Gas Equipment, Inc., Catalog

THE Natural Gas Equipment, Inc., of Los Angeles, has issued a new catalog that will be of interest to men interested in automatic pressure regulation for gas, steam, liquids or vapors. The catalog contains new information and new equipment just developed, arranged in such a manner as to make it easy to find and use.

Corrosion-Resisting and Heat-Resisting Alloys Book

THE American Society for Testing Materials has issued a book containing tables of data on Corrosion-Resisting and Heat-Resisting Alloys. These tables were prepared by the Society's committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and related alloys. They are considered to be an especially valuable compilation of information on corrosion-resistant and heat-resistant alloys.

They are available in the form of eleven large tables in a special binder at $1.50 per copy. A Prospectus will be furnished on request to all those interested by addressing the American Society for Testing Materials, Philadelphia, Pa.

New Petroleum Dictionary

A GLOSSARY of 234 pages, containing some 3,500 definitions of technical and non-technical terms in use in the petroleum industry, has just appeared under the title "Petroleum Dictionary for Office, Field and Factory," by Hollis P. Porter, an engineer of long and varied experience in the production of oil. Besides words in common use in the field and refinery that are peculiar to the oil business, the glossary contains technical terms, geological, chemical, and general engineering, that relate directly to

some phase of the petroleum industry. The definitions are concise and easily understood. Apparently an effort has been made to make them as accurate as possible by consulting a wide variety of authoritative sources of information.

This is one of the most comprehensive glossaries of its type relating to the oil industry that has yet been attempted. To those engaged within or to the layman without the oil industry it is a handy reference book. It is published by the Gulf Publishing Company, Houston, Texas. Price, $3.00.

A. O. Smith Corporation Book

A. O. SMITH CORPORATION, Milwaukee, Wis., has published bulletin No. 510 entitled "The New Way of Designing and Building Gas Lines with Smithwelded Pipe."

This booklet has been issued, and will be sent upon request to anyone interested, to make better known the benefits to be derived from the use of Smithwelded pipe and from the Smith methods of laying.

The "Petreco" House Organ

"THE Electric Dehydrator" is the title of a bright, interesting little house organ now being issued by the Petroleum Rectifying Company of California for the purpose of disseminating information relative to "cut" oil in general, and to the Petreco process of electrical dehydration in particular.

The Electric Dehydrator is a four-page publication, well illustrated, printed in two colors, 8½ x 11 inches in size, and punched so that it is suitable either for filing in standard letter files or binding in standard ring or post binders.

Copies may be obtained by writing to Petroleum Rectifying Company of California, 714 Security Title Insurance Bldg., 530 W. Sixth Street, Los Angeles, Calif.

Some interesting and valuable articles on electric dehydration, results, field conditions, etcetera, are planned for future issues.

New Link-Belt Chain Booklets

THE Link-Belt Company, 200 South Belmont Avenue, Indianapolis, Ind., has printed several books, which will be sent gratis upon request, to oil men.

Book No. 1050, is a 32-page comprehensive data book devoted to Promal Chains. Promal is Link-Belt's new, stronger, longer wearing metal for cast chains, for power transmission and conveying services.

"Keeping Pace with the Oil Industry," is the title of Book No. 1259, which describes the tremendous progress that has taken place in the oil industry and the advancement and improvement of Link-Belt Hyper type chain that has kept it in pace with other improvements.

Electrical Resistance of Contacts Between Nuts and Bolts

SOMETHING of value and interest to everyone concerned with electrical construction and design has been contributed by the findings of the Bureau of Standards in their Research Paper No. 227, which gives the results of an investigation of the electrical conductivity of Dardelet threads and of American National coarse threads on three-quarter-inch bolts and nuts made from both ferrous and non-ferrous metals.

Wherever electric current passes through a threaded connection it is of great importance that the thread contacts be maintained constant under a substantial pressure so as

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THE CHAPLIN-FULTON MFG. CO.

Manufacturers of Regulators for Industrial Gas Service

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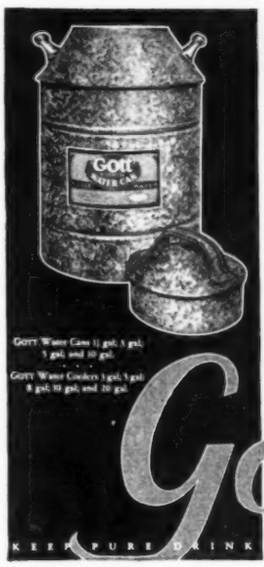

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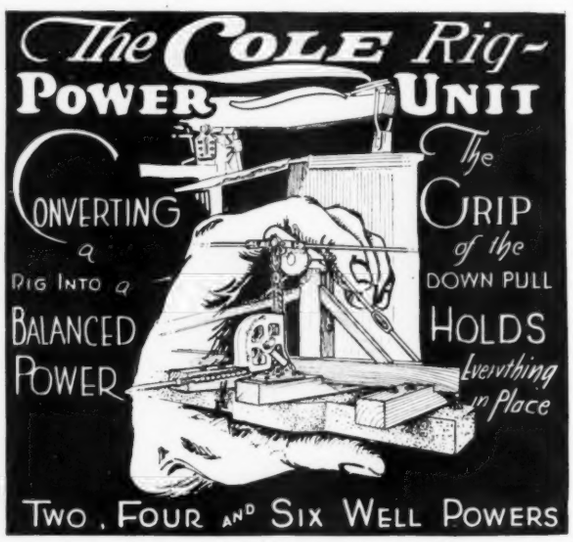
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WASHINGTON DERRICKS
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Western Representative:
RIG EQUIPMENT CO., 1224 N. W. 33rd St., Oklahoma City, Okla.

to reduce electrical resistance and to insure uniform electric conductivity even under extreme vibration and shock.

A reprint of this test may be secured upon request to the Dardelet Threadlock Corporation, 120 Broadway, New York City.

New Dreadnaught Folders

THE Beaumont Iron Works Co., of Beaumont, Texas, has published two new folders for insertion into its loose-leaf type catalog.

One folder covers the Dreadnaught Fishtail Bit and Drill Collar to replace the small single folder covering fishtail bits and drill collar prices on pages 12 and 13.

A Treatise on Oil and Gas Separation

WILLIAM McGRAW and E. H. Adams of the Trumble Gas Trap Company, 756 Subway Terminal Building, Los Angeles, Calif., have prepared and recently had published their third bulletin on oil and gas separation. In this new booklet, entitled "A Treatise on Oil and Gas Separation," they have endeavored to give a more comprehensive treatment of the subject than has been possible before.

They feel that this is possible because of the continued research into this matter and the widened scope of their experience since the last bulletin was issued in 1928.

This booklet is distributed with the compliments of the Trumble Gas Trap Company. It is well illustrated with drawings and pictures, and contains much engineering data on the construction, installation, operation, sand troubles, capacity, scrubbers and other interesting topics connected with separation. Many of these chapters contain helpful, practical information in addition to the engineering features.

Turbo Equipment Bulletin

A NEW bulletin giving descriptive information on Turbo Equipment has been issued by the Turbo-Mixer Corporation, 250 East 43rd Street, New York. Principles, Advantages, Construction, Drives, and Wide Range of Applications are topics of discussion in this bulletin on this equipment designed for liquid mixing. It is well illustrated, comprehensive, and interesting.

New Bulletin on Oil Refining Equipment

A NEW bulletin on equipment for oil refineries has recently been issued by the Coppus Engineering Corporation, manufacturers of ventilating and mechanical draft equipment, blowers, turbines and turbo generators.

It gives a comprehensive idea of the type of equipment made by this company for special application to the oil refining industry and is profusely illustrated. Informative description and data are given on fans for recirculation of flue gases in the cracking process, 1 to 60 and fractional horsepower turbines, turbo generators, hot job fans, and ventilating and forced draft apparatus.

A copy of this bulletin will be sent to all interested parties if the company is addressed at their main plant, 344 Park Avenue, Worcester, Mass.

Interlocked Control

INTERLOCKED Control in the Modern Oil Refinery, Bulletin No. 9, has been issued by the Brown Instrument Co., and is available to any responsible refiner or oil company official who desires it. Still operating factors are inter-dependent, and control devices must take this relation into account. Interlocked Control is discussed complete with data, charts and diagrams.

Neilan Has New Manual Control System

NEILAN CO., LTD., manufacturers of automatic control and regulating devices, Los Angeles, is now marketing the new and perfected Neilan Remote Manual Control System. This device provides a moderately priced piece of equipment, consisting of a handwheel and a control pressure indicating dial, operating in conjunction with a special pilot valve, which may be used to operate remote valves throughout industrial plants. A new 16-page bulletin, profusely illustrated, may be obtained from Neilan Co., Ltd., 641-651 Santa Fe Avenue, Los Angeles.

Foster Wheeler Gets White Star Contract

THE White Star Refining Company has contracted for a Debutanizer and Stabilizer Plant to be furnished by the Foster Wheeler Corporation. This plant will be installed at Detroit, Michigan, in connection with an existing gasoline absorption plant. The new unit will also process pressure distillate in addition to natural gasoline. The peak capacity of the plant will be 165,000 gallons per day of pressure distillate and 50,000 gallons per day of raw gasoline from the present absorption plant.

National Supply Distributor for Petroleum Engineering, Inc.

NATIONAL SUPPLY COMPANY, with main offices at Toledo, Ohio, has recently completed arrangements with the Petroleum Engineering, Inc., of Tulsa, Oklahoma, to be distributor and representative for Petroleum Engineering, Inc., in the sale of gasoline plants, refinery units and fractionating equipment for special refinery products.

Talking-Movie Picture of Pipe Manufacturing

SPANG, CHALFANT & COMPANY, INC., of Pittsburgh, Pa., pioneer pipe manufacturers, have again pioneered in the industrial talking picture field, being the first to use this method of presenting five reels of exceptionally interesting and informative moving pictures, with incidental music and explanations, of their welded pipe mills at Etna, Pa., and Sharpsburg, Pa., and their seamless mills at Ambridge, Pa.

The introductory scenes in the presentation, entitled "Spang's First Century," depict the early mode of transportation and the costumes of the period in which the manufacture of pipe was begun by the originators of the present firm of Spang, Chalfant & Company, Inc.

This company was started over a century ago, in 1828, at Etna, Pa., the present site of the oldest operating pipe mill in America.

The process of manufacture is developed step by step from the blast furnace production through the numerous and exacting operations of rolling, welding, piercing, threading, etc.; the various proceedings being shown in exceedingly clear and understandable detail, with diagrammatical illustrations adding to the value and clarity, the picture closing with descriptions of distributing facilities, both for domestic and foreign pipe consumers.

These films, which are being shown throughout the country, are meeting with enthusiastic reception and present an opportunity to visualize one of the important phases of American industrial progress.

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New Designs Feature of . .

ELECTRIC

By WILL

Will C. Barde, electrical engineer, is a pioneer operator of electric rigs and was in charge of many of the wells drilled with electricity at Oklahoma City.

IN recent years manufacturers of electric drilling equipment have devoted much time and attention to the development of more suitable electric machinery for rotary operations. Increased oil field installations acknowledge the accomplishment of vast improvements, in the design and construction of this type of equipment, resulting from this experimental and research work.

Electric drilling has been proven successful in deep producing areas by the newer type motors. Heretofore, electric drilling has been confined mostly to shallow depth operations —a success for a number of years.

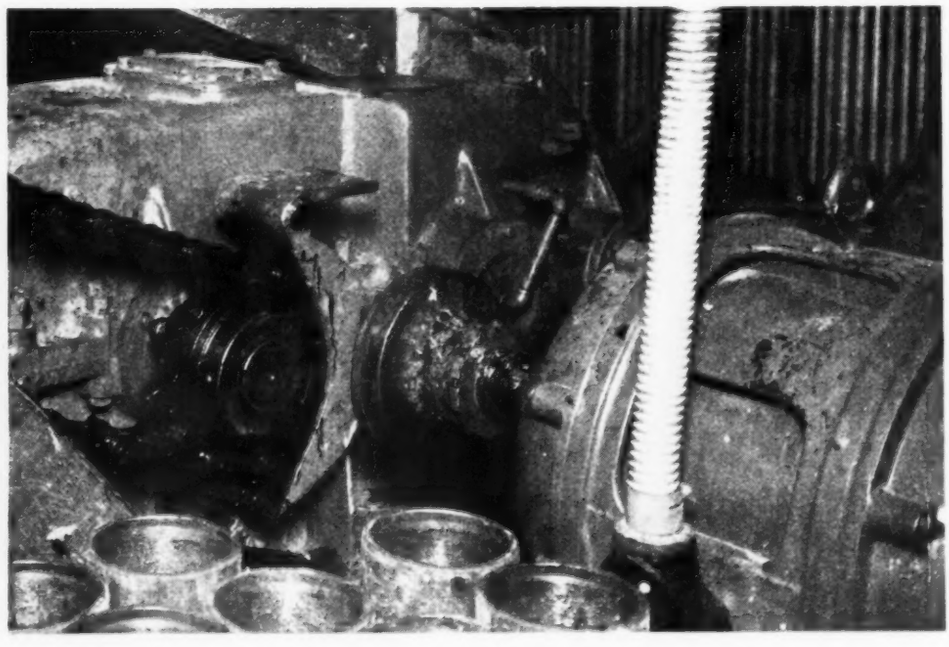
Improvements included such features as greater horsepower, wider ranges of speed, interchangeability of motors, additional safety and sturdiness in motor construction and better adapted controllers. The increased power and speed range has been very beneficial to the use of electricity as a means of drawworks operation and for rotating. The new motors for drilling and running the slush pumps are of the same speed, size and design and in case of emergency a quick change can be made, thereby increasing the "hole safety factor." These motors and controllers are a long step from the practice a few years ago of recommending the same type motor and controls for rotary drilling as used in cable tool operations.

It was not until the discovery of the Oklahoma City field, with its more than a mile deep producing horizon, that the need of changes in the construction and design of electric rotary drilling equipment was apparent. Larger drawworks, heavier equipment in general, were in use to withstand the severe tests and strains of drilling this pool. These made demands upon prime movers that the electric machinery of that day was not built to efficiently accommodate. Early in the year 1930 several of the leading electric equipment manufacturers placed on the market new designs, constructed to meet the drilling requirements of this area—or greater drilling depth.

The first electrically drilled wells at Oklahoma City were drilled with 150 horsepower motors for operating the drawworks, and 150 horsepower and 200 horsepower motors on the slush pumps. Considering the overload and abuse this size of equipment received its work was remarkable.

The Hall & Briscoe, Inc., No. 2 Lindsey well was drilled to 5,800 feet, using six-inch 31.9 pound pipe, with extra heavy tool joints, and even at this depth and load the 150 horsepower equipment operated satisfactorily at 125 to 150 per cent overload. This well would have been drilled deeper with the same equipment, but the derrick was destroyed by tornado. While rebuilding the rig, 250 horsepower equipment arrived and was installed. This new motor was rated at 250/85 horsepower, or in plain speaking was two motors in one by use of suitable control apparatus. It gave 85 horsepower for drilling or rotating and protection preventing twisting off of the drill stem. The 250 horsepower side of the motor was used for hoisting. While this motor was under test it developed as high as 605 horsepower without excessive slippage.

These large motors being of different speeds it was necessary to change the sprocket ratio. The 150 horsepower motor had a speed of 1,200 revolutions per minute and was operated with a 19-tooth sprocket on the reduction gear and a 27-tooth sprocket on the line shaft. The 250 horsepower motor was of 720 revolutions per minute and was connected up with a 21-tooth sprocket on the reduction gear and a 27-tooth sprocket was installed on the line shaft. These gave approximately the same fast line speed as on



Coupling attachment, gear box and motor in use on a drawworks.

ROTARY Drilling Equipment . .

C. BARDE

the older type. The same reduction gear ratio was used on both motors, it being 3.29 to 1. From the foregoing it may be seen that to increase the power does not make it necessary to change or junk all equipment.

The best arrangement for rigging up these motors is to couple the motor by a flexible coupling to a gear unit. This coupling must allow free end play of rotor. The drawworks line shaft is driven by standard rotary chain from a sprocket on the low-speed shaft of the gear unit. Special gear units have recently been developed. These units can be used with the same motor on either 50-cycle or 60-cycle power circuit by changing the size of the sprocket to compensate for the difference in the motor speeds on these frequencies.

The new (two in one or star delta) electric motors offer economy from the operation standpoint, as any electric motor is more efficient at or near its full load rating.

Electric controls of grid or resistance construction are practically the same on all controls, but contactors, master and drum controls vary greatly. The master controller reverses the motor as well as regulates its speed, but does not carry the primary current. A separate contactor panel is supplied for this purpose.

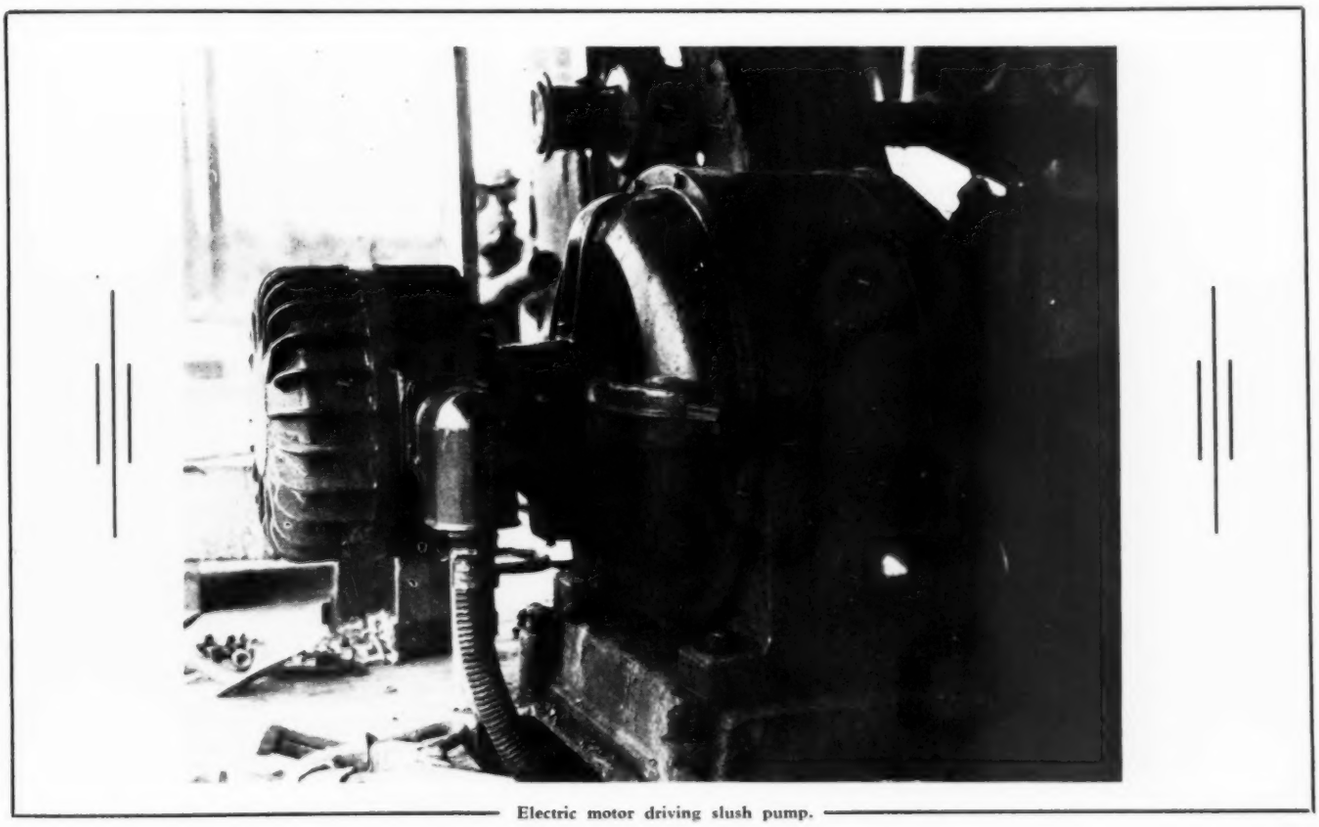
There are two types of the master drum and magnetic controls, namely, open or air-break, and the closed or protected—submerged in oil type. The open type is assembled in steel cabinets with steel doors to protect it from mud or falling objects, and is often used where there is lots of gas. This type was used extensively in drilling operations at Oklahoma City.

The protected oil-submerged type has all its contacts immersed in tanks of oil. This type may be used where there are amounts of gas or any explosive mixtures without danger of fire or ignition of the gas. The oil retards the burning of contacts by quickly extinguishing the arc.

Care should be exercised in the selection of the correct oil for this type control. When moving from one location to another the oil should be protected from dirt and water. A good policy is to filter the oil at each new location. There is no expense to this operation, it requiring only time and close attention.

The main controller gets the heaviest duty on a drilling rig, and the frequency with which the contacts must normally be renewed depends mostly upon its duties and the number of trips, etc. The discovery of a new alloy in which contactors are dripped or treated has eliminated the tendency of this piece of equipment to stick and case burning. The newer electric controls also have greater contact area, which has aided in stopping the "burning" action on contactors, and are also equipped with better arc extinguishers and shields. The improved controls can now drill from one to five complete wells with very little attention being paid to the contacts.

The year 1931 should witness further improvements in electric rotary drilling motors. The great knowledge secured during 1930 will be the basis for any changes in design and construction. Designs already past the preliminary stage will be completed during this year by engineers of electric equipment manufacturers and may offer many important advancements.



Electric motor driving slush pump.

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Pomona Pump Co., Pomona, Calif.

POMONA TURBINE PUMPS

A Construction Superintendent Takes Wings

HOW to find a modern method of keeping in touch with modern methods of pipe line construction, with construction crews operating simultaneously in all parts of the country was solved when it was decided that I should travel by airplane. Since that time more than 80,000 miles have been covered in the Waco "10", powered with a Wright Whirlwind 220 H. P. motor.

Within the last few years, a new development has taken place in gas and oil pipe line construction—that of welding

the various lengths of pipe together as the pipe line is laid. The A. O. Smith Corporation pioneered welded steel pipe, and were able to supply trained welders from their shops for field welding on construction jobs. With a number of different pipe lines under construction in various parts of the country, and a number of welding crews working on each line, it became increasingly difficult properly to supervise distribution and installation due to the great loss of time occasioned by traveling long distances. In addition to distance, means of transportation often proved lacking or insufficient in the unsettled regions traversed by most pipe lines. Where rail communications are possible trains are slow and are run on schedules varying from one train daily to two per week. Automobile transportation over unimproved roads often is slow and tiresome and sometimes, especially in wet weather, impossible.

After a particularly heart-breaking inspection trip of 6,000 miles which consumed four weeks, three of which were spent in riding and only one in actually working, it was decided that I resort to airplane travel.

As I was already a licensed pilot, I was furnished with the Waco "10" without further delay. I had done no cross country flying outside of the state of Wisconsin until that time, so the ship was fitted with dual controls and it was agreed that I would be accompanied by another pilot on the first few trips.

In flying 80,000 miles in a year and a half, all kinds of weather has been encountered. However, only one flight was abandoned entirely and flights have been delayed from four to 24 hours only on eight different occasions. The abandoned flight was made necessary in January, 1930, when in Wyoming, and a stretch of 40 degrees below zero weather set in.

The ship has been landed on and adjacent to pipe line rights-of-way wherever sufficient landing space could be found, in country varying in character from the Bad Lands of Montana and North Dakota to the desert of San Joaquin Valley in California. To date, only two slight mishaps have

occurred, both without personal injury to pilot or passenger. Forced landings, on account of bad weather, have been made frequently without harm, and one forced landing on account of fuel exhaustion and one on account of motor failure have also been experienced without harm to ship or pilot.

The time saved in traveling from line to line and from work accomplished when four or five gangs are working on the same line is almost unbelievable compared to what would have been the result if ordinary means of transportation had been used. When working four welding crews in California, for instance, it was possible to visit each gang every day, whereas by automobile it would have required at least a week's work. In one place near the Kettleman Hills with a gang working on each side of the mountain it was possible to fly directly over the hills to accomplish in 10 minutes what required four to five hours in an automobile detouring around them. In Texas, with four welding gangs on one line the same result was secured. Recently, the entire Mokan and Chicago lines were flown over in one day, and visits made at each welding crew.

Great saving in time, plus the ability to be at places when required, with most of the time spent in actual supervision rather than in traveling, is the greatest asset of airplane travel in connection with pipe line construction work, as I have found it in my work as field superintendent.

Wickwire Spencer Moves Into New Building

WICKWIRE SPENCER SALES CORPORATION has moved from the Philtower building to its new building at Elgin and Archer, Tulsa. The new building affords ample warehouse space in addition to office room.

Wickwire Spencer Sales Corporation are sales representatives for Wickwire Spencer Steel Company, manufacturers of Wickwire Spencer Wire Rope and other products.

Moorelane Company Has New Line

Watson-Stillman Company, Roselle, N. J., has appointed The Moorelane Company of Tulsa, Oklahoma, exclusive representative for the sale of hydraulic machinery and accessories in the state of Oklahoma.

The Moorelane Company covers the industries of this section with an ample staff of field engineers.

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Have You Any Interesting Oil Industry Pictures?

. . . For use in the Pictorial Petroleum Section, The Petroleum Engineer desires unusual and interesting photographs. These may be of field scenes, new installations, new hook-ups, individuals, or any subjects likely to appeal to men in the petroleum industry. Especially do we want pictures of "old-timers" who are still active in the business and views with a foreign setting.

If you have such photographs, we shall appreciate your permitting us to reproduce them in our pictorial section. Extreme care will be exercised in handling them and they will be returned in the same condition as received. Kindly address photographs to

THE PETROLEUM ENGINEER
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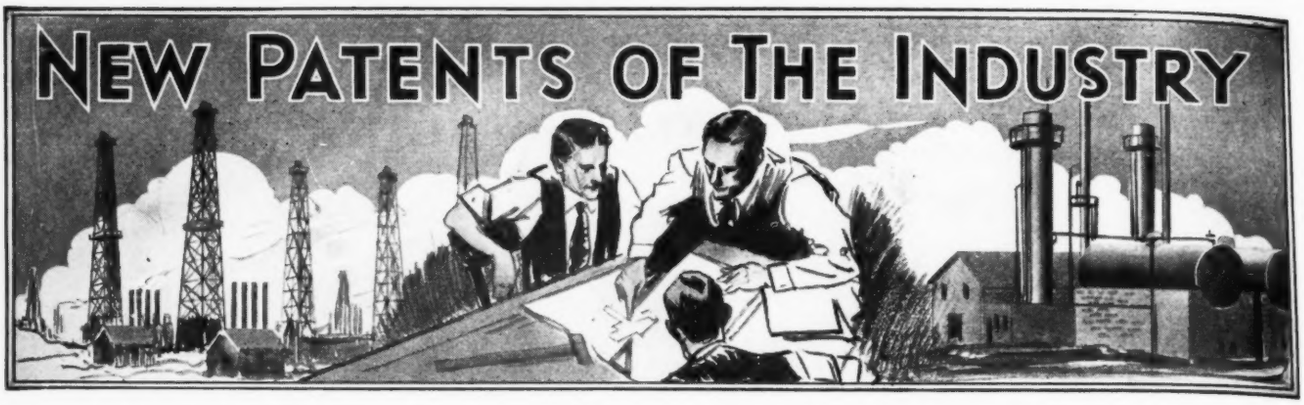
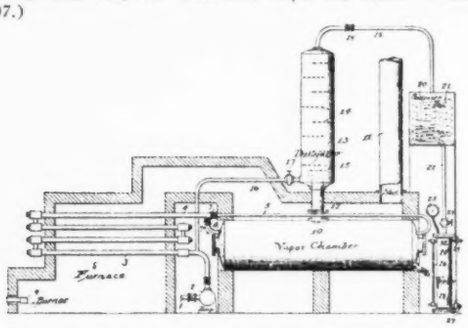
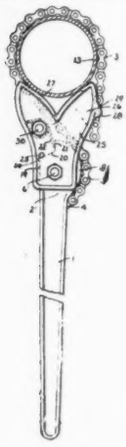


1,791,617. APPARATUS FOR CRACKING OIL. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill., a Corporation of South Dakota. Filed Apr. 25, 1921, Serial No. 464,368. Renewed Sept. 28, 1926. 1 Claim. (Cl. 196—107.)



In an apparatus for cracking oil, the combination with a furnace, of a cracking coil disposed therein through which oil is passed in a single passage to be subjected to a cracking temperature, an enlarged horizontal vapor chamber separated from said coil, of valve controlled means for passing heated oil in liquid phase from said coil into either of the opposite extremities of said horizonal vapor chamber, means for increasing the velocity of the oil as it reaches points near the entrances to said vapor chamber, a condenser in communication with the vapor chamber, and means for maintaining a superatmospheric pressure on the oil undergoing treatment.

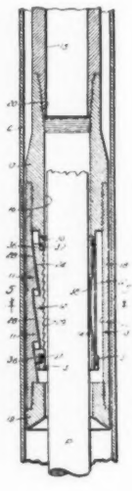


1,792,401. CHAIN TONGS. Sam Sorensen and Joseph Arvid Peterson, Houston, Tex., assignors by direct and mesne assignments, to Gearench Manufacturing Company, Houston, Tex., a Corporation of Texas. Filed Feb. 4, 1929. Serial No. 337,183. 4 Claims. (Cl. 81—68.)

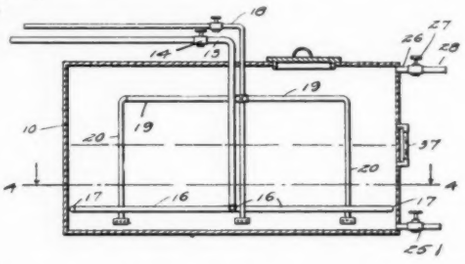
1. A chain tongs comprising a handle, a head thereon having a rounded portion on one side thereof, a chain attached to one side of said handle and engaging about said rounded head, a jaw pivoted upon said head, means on the side of said jaw adjacent said chain to detachably engage said chain after it is passed about the pipe, whereby the swinging of said handle in one direction will pull upon the end of the chain attached thereto, and a spring on said jaw bearing against said head to hold said chain against said pipe.

1,791,529. FISHING TOOL. Nelson Lamoureux, Whittier, and Michael W. Lukes, Compton, Calif. Filed Aug. 12, 1929. Serial No. 385,236. 13 Claims. (Cl. 294—102.)

1. A well tool of the character described including, a tubular body, a wedge part on the inner wall of the body, a slip mounted in the body for cooperative movement along the wedge part and for lateral movement off the wedge part.

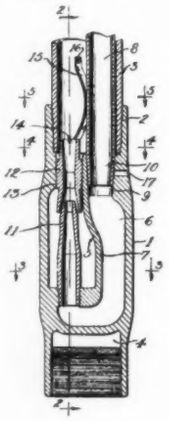


1,791,695. APPARATUS FOR TREATING OIL. William Yantis, Cushing, Okla. Filed Feb. 24, 1928. Serial No. 256,789. 6 Claims. (Cl. 196—5.)



2. In an oil treating apparatus, a tank adapted to contain water, a series of alternately arranged nozzles and distributing heads within the tank below the surface of the water therein, the nozzles being arranged in a common plane and the distributing heads being arranged below the planes of the nozzles, an oil inlet pipe communicating with the nozzles, and a steam pipe communicating with the distributing heads.

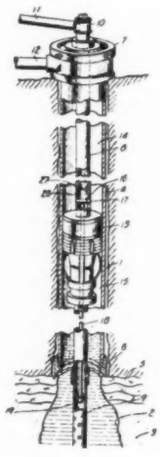
1,791,513. GAS LIFT PUMP. Joseph Howard Slocum, Long Beach, Calif. Filed July 3, 1929. Serial No. 375,770. 12 Claims. (Cl. 103—260.)



1. In a gas lift pump for deep wells, the combination of a pump body having a high pressure chamber formed therein for receiving the high pressure gas and having an inlet on the upper side of the body, said inlet having an eccentric tapered socket, a down-pipe extending down from the mouth of the well for leading the high pressure gas down to the pump body, and having a tapered tip at its lower end capable of seating in the said socket, a flow pipe enveloping the down-pipe and attached to the body and located so that the down-pipe lies adjacent to its side wall, a nozzle communicating with the said high pressure chamber for delivering the high pressure gas or air into the lower end of the flow pipe, and means associated with the nozzle for entraining the pumped liquid.

1,792,107. APPARATUS FOR FLOWING WELLS BY AIR LIFT. Wilbert L. Martin, Tulsa, Okla. Filed Feb. 1, 1928. Serial No. 251,036. 3 Claims. (Cl. 103—233.)

1. In combination with well casing, a packer in the casing, tubing extending through the packer, a conduit in the tubing communicating with the casing above the packer and terminating in the tubing below the packer, a cap on the lower end of the conduit having a distributing chamber and ducts leading from said chamber to communication with the casing below the packer, nipples in the tubing communicating with the casing above the packer, and means for delivering air under pressure to the casing above the packer.



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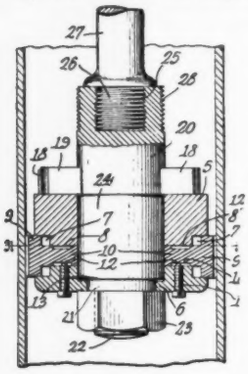
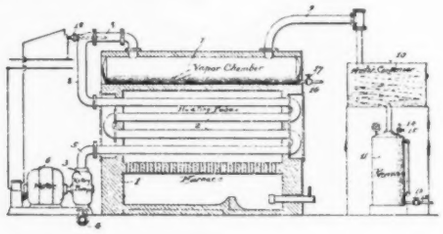
1,790,761. TOOL. ARTHUR P. ORTOLON, Cotton Valley, La. Filed Feb. 20, 1928. Serial No. 255,781. 1 Claim. (Cl. 81—72.)



A tool for removing well casing sections, comprising a body portion having a central circular opening and having lateral openings communicating with the central opening, gripping jaws, extensions on the jaws and fitted in the lateral openings, means for normally moving the jaws laterally, a mandrel extended through the central opening, said mandrel being oval in cross section and adapted to engage the extensions of the jaws to force the jaws laterally, stops extending upwardly from the upper surface of the body portion, at opposite sides of the central opening stops, extending laterally from the mandrel and adapted to engage the first mentioned stops to restrict movement of the mandrel, and means for limiting outward movement of the jaws.

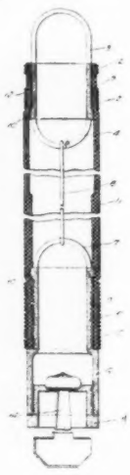
1,791,566. PROCESS AND APPARATUS FOR TREATING HYDROCARBONS. LESTER KIRSCHBRAUN, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a Corporation of South Dakota. Filed Sept. 1, 1920. Serial No. 407,419. 9 Claims. (Cl. 196—132.)



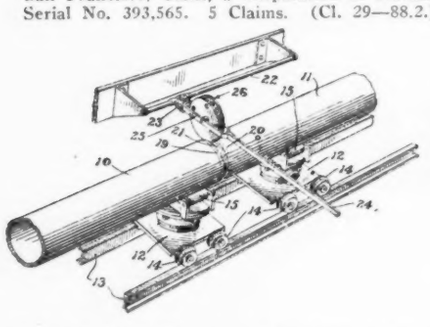
3. In the art of converting heavy into lighter oils, wherein an advancing stream of oil is heated to a cracking temperature and then transferred to a reaction zone, the improvement consisting in controlling the temperature imparted to the oil stream being heated responsive to variations in the thermal condition of the oil stream as it is transferred to the enlarged zone to maintain said stream as it is transferred to the reaction zone at a substantially uniform predetermined temperature.

1,792,301. BAILER. COLONEL C. HEETER, Butler, Pa., assignor to C. M. Heeter Sons & Company, Inc., Butler, Pa., a Corporation of Pennsylvania. Filed Dec. 12, 1927. Serial No. 239,339. 5 Claims. (Cl. 166—19.)

1. In a bailer, an upper member having a bail formed on the lower end thereof, a lower member having a bail formed on the upper end thereof, an elongated tubular member of rubber extending between said upper and lower members, and load carrying means directly connecting said bails.



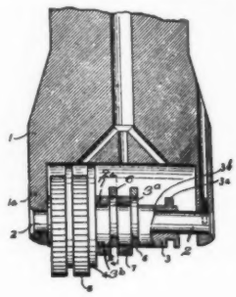
1,791,793. SPREADER FOR PIPE-WRAPPING MACHINES. ALFRED ALLEN CHAMBERS, Chicago, Ill., assignor to General Paint Corporation, San Francisco, Calif., a Corporation of Nevada. Filed Sept. 18, 1929. Serial No. 393,565. 5 Claims. (Cl. 29—88.2.)



1. In a spreading device for axially separating rotating cylindrical bodies, the combination of a support, a lever pivotally mounted upon said support adapted to be brought down over the rotating bodies to be separated, and a disc having its opposite surfaces disposed at an angle and adapted to be projected between the meeting ends of the rotating bodies to be separated and rotate in contact therewith so as to effect an axial displacement of the bodies as they rotate.

1,791,767. ROLLER BIT. JOHN C. STOKES, Houston, Tex., assignor to Reed Roller Bit Company, Houston, Tex., a Corporation of Texas. Original application filed Aug. 23, 1927, Serial No. 214,826. Divided and this application filed Jan. 26, 1928. Serial No. 249,528. 3 Claims. (Cl. 255—71.)

1. In a roller bit, a head having a cutter recess, a plurality of disc shaped roller cutters, a plurality of disc shaped cleaning devices, and a support mounted in said recess and having a plurality of eccentric portions, and sectional bushings for said portions, said cutters and cleaning devices being so mountable on said bushings that said cleaning devices are adjacent and eccentrically rotatable with respect to said cutters.

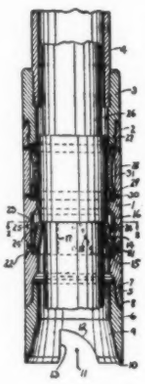


1,791,859. FISHING TOOL. CHARLES HENRY BROWN, Breckenridge, Tex. Filed May 11, 1928. Serial No. 277,083. 3 Claims. (Cl. 294—100.)

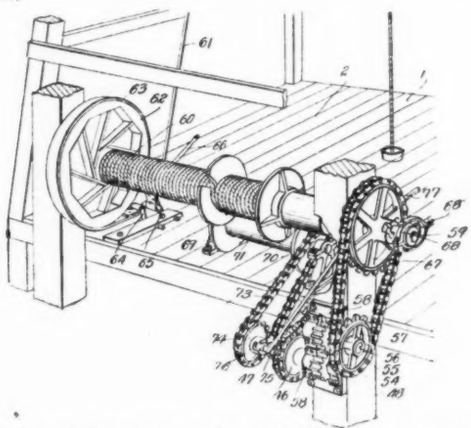
1. Improvements in a fishing tool, a barrel, a connection at the upper end of the barrel, a mandrel slidably mounted in the barrel, said mandrel carrying a set of flexible steel fingers with inwardly hooked and downward and inward slanted top ends which are assembled on the mandrel by a spider rigidly attached to the mandrel, a clamping plate resting on top of the hooked ends of the fingers and causing the hook on each finger to engage the top of the spider, a clamping sleeve that is pulled up on the slanted portions of the fingers, clamping the fingers securely in position, means for closing the fingers together at the bottom and holding them closed.

1,788,829. OVERSHOT FISHING TOOL. ELLSWORTH GRAY, Houston, Texas, assignor to Gray Tool Company, Houston, Texas, a Corporation of Texas. Filed Sept. 19, 1927. Serial No. 220,406. 9 Claims. (Cl. 294—99.)

1. A fishing tool comprising a tubular body having a dog-receiving recess on its inner side, arcuate dogs in the said recess, means retaining the lower ends of said dogs loosely in said recess, means to hold the upper ends of said dogs resiliently inwardly, means on the forward edges of said dogs beveled to engage the work and cut into the same to force said dogs outwardly upon rotation with respect to the work.



1,792,108. WELL-DRILLING MECHANISM. RICHARD C. MASON, Tulsa, Okla. Filed Oct. 11, 1926. Serial No. 140,809. 1 Claim. (Cl. 254—185.)



In apparatus of the character described including a derrick including posts, a band wheel and a planetary gear speed change transmission, a bull wheel supported by the derrick posts, a calf wheel located against the bull wheel, bearings mounted on one of said bull wheel supporting derrick posts, a jack shaft mounted in one of said bearings and projecting from one side of said post, a counter shaft mounted in the other bearing and extending oppositely from said post, a clutch controlled connection between the transmission and the jack shaft for rotating the jack shaft in the same direction as the transmission, a clutch connection between the jack shaft and the calf wheel for rotating the calf wheel in the same direction as the transmission, meshed gears on the jack shaft and counter shaft for rotating the counter shaft oppositely to the jack shaft, and a clutch controlled connection between the counter shaft and the bull wheel for driving the bull wheel from the counter shaft in reverse direction to the rotation of the jack shaft.